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PLOUGHING UP LEYS IN THE FENS

FRANK H. GARNER, M.A., M.Sc.

IN a previous article* a brief description was given of putting land down to leys under fenland conditions. The present article is intended to show the procedure in reverse, namely, the ploughing up of leys and bringing the land back to arable cultivation. After leys have been down for a time, they may for various reasons have to be ploughed again. The first reason is to keep the right balance between leys and arable where, on account of other land being laid down to grass, some that has been down for a period of four or five years may have to be ploughed up. Secondly, through over-grazing and perhaps excessive treading, the land may become bare, and weeds, particularly chickweed in fenland leys, may grow around gateways and other places. The third case, and one which is very common after seeds have been taken from a ley for several years, is where the ley appears to "run out" and the yield of seed falls. For these various reasons it becomes necessary to plough and crop land for a few years before re-seeding. As a general rule, it is essential to graze the field well and plough immediately after, so making it much easier to bury the grass and any weeds that may be present. The actual time of ploughing will depend to a certain extent on the cropping plan to be followed. Successful ploughing has been carried out in December for drilling or planting early in the spring, but where the fields have a bad reputation for blowing, ploughing in March or April, followed almost immediately by drilling, has proved very satisfactory.

Three Methods of Ploughing In the past, three methods of ploughing have been adopted, and in all instances it is essential that the turf should be completely buried. The first method is straightforward deep ploughing (14–16 inches is normal under fen conditions). Such ploughing will ensure the complete burying of all greenstuff in one operation, and any couch that may be present will be smothered. The second method is to disc the surface and plough later. A thorough discing of the surface (carried out in several directions) will break up the turf, which can then be buried easily. The ploughing need not be quite as deep as in the previous case ; about 10 inches will give satisfactory results. The third method is what is known as " double ploughing," that is, first to plough a top layer to a depth of, say, 3–4 inches and then either to cross-plough to a greater depth, or to have a second plough following immediately behind the first (in both these latter cases the ploughs must be of the single-furrow type). In the former case, the plough will bury the turf satisfactorily, because under fen conditions the turf is not as solid as it is under some

* *Agriculture*, October, 1950

others. Consequently, cross-ploughing produces satisfactory results, provided it is carried out to a depth of 8–9 inches and the first ploughing has been not more than half that depth. With the double ploughing there is a further modification when two ploughs are used. The first single-furrow plough will take off the turf and drop it into the space left by the previous round of the deep plough ; the latter will then put a furrow slice on top of the turf. This second ploughing will be of the order of 10–12 inches.

As a general rule, with all ploughing of leys in the fens, the roll should follow immediately behind the plough ; in fact, sections of rolls are sometimes fixed behind the ploughs. With the blowing fen soil, the conservation of moisture so obtained is particularly important, and in some instances the land should be ploughed, rolled and drilled almost in a matter of a few hours, so that the minimum of moisture is lost and the seed has a chance to germinate under moist conditions.

A Suitable First Crop After a ley the land should be in good heart and a root crop would, therefore, seem to be the most satisfactory crop to cash fertility without running the risk of crops being laid. In the past potatoes have often been the first crop, but one difficulty has been the presence of wireworms, which have played havoc with it. Early potatoes, if they can be grown, are satisfactory, because they are lifted before the late summer when wireworm damage to potatoes itensifies. Deep ploughing is essential for potatoes, otherwise when the potatoes are ridged up, turf is brought to the surface so exposing it before it is completely dead ; it may then start into growth and become a nuisance in the potato crop. Turf will also give trouble when earthing-up the potatoes. Since, in some instances, leys have been put down to combat potato root eelworm, it may be undesirable to take potatoes as a first crop after a ley, as this will not give the land long enough rest from potatoes. It is recommended that after a crop failure due to eelworm, the land should be rested from potatoes for a period of five years after all ground keepers have been destroyed ; this may mean a rest of seven or more years in all.

Sugar beet is another crop which has been taken immediately after a ley with considerable success. If the ploughing has been thorough and the turf well buried, the drilling of beet will give no trouble. The coulters will run satisfactorily and an early start can be obtained. If, on the other hand, the turf has not been well buried, it can be a serious hindrance, giving trouble at the time of drilling and during hoeing. There is, however, also a risk of wireworm causing trouble with this crop, but fortunately there are two ways of meeting the problem. One is to apply a benzene hexachloride insecticide dust to the soil before drilling takes place ; this method, in the writer's experience, has been successful under fenland conditions. A warning note should be sounded, however, that, when soil is treated in this way, there is a risk that for a period of two years produce grown for human consumption (e.g., potatoes) may be tainted. The alternative is to treat the sugar beet seed with specially prepared dressing containing benzene hexachloride mixed with an appropriate fungicide, or to buy it so treated from the beet factory. This has also been tried out by the writer and found satisfactory, provided the wireworm population is not too high ; it also obviates the risk of tainting subsequent crops. If a high wireworm count is likely the soil should be treated, and in very bad cases it may be a wise precaution also to sow treated seed. The importance of attacking wireworm by mechanical means should not be overlooked, as the process of consolidation by rolling helps plant establishment and may restrict the movement of wireworm in the soil and so reduce the damage they may do.

Another useful crop that can be taken after a ley is beans. This crop can stand up to wireworm attack, and although, under fenland conditions, there is some risk of the crop being laid, good yields have been obtained.

The next crop to follow any of the above three first crops will usually be a cereal. This is nearly always wheat, except, perhaps, on the lighter fen soils, where it may be rye, oats or barley.

Thus we have a possible rotation consisting of sugar beet, wheat, potatoes, wheat and then ley again. There is much in favour of this particular sequence of cropping, since if wireworms are troublesome the soil can be treated against them for the sugar beet, and by the time the potatoes are due the soil should be free of any taint. If the risk of taint still exists, then a second corn crop should be taken, or perhaps peas or beans may be substituted for the potato crop. This would, of course, lengthen the rotation to six or eight arable crops instead of four years ley and four years arable.

Manuring the Ploughed-up Ley With regard to manuring, no farmyard manure should be necessary, since sufficient should be left from the grazed ley, but a mixture containing a good proportion of phosphates and potash and a little nitrogen should be used at the rate of 6–8 cwt. per acre for the first root crop and 2 cwt. more for the second root crop in the rotation. Experience has suggested that it is not wise to cut down materially the manuring of the root crops on the supposition that the land will contain a lot of nutrients ; in actual practice the manuring of the land after the ley should be much the same as if an ordinary arable root crop had been taken in rotation.

Experience has also shown that the top dressing of sugar beet after singling is advantageous, as it helps the crop to recover ; this treatment may be important if the land is subject to blowing, and it is especially useful for beet after ley and wherever it occurs in the rotation. On good fen soil the cereal crop need receive no fertilizer, but on the poorer fenland a dressing of 2 cwt. per acre of a complete fertilizer can be combine drilled for both autumn and spring-sown corn.

Another point worthy of mention is the improvement in the texture of the soil that results from the ploughing in of the turf. This turf reduces the amount of stickiness, which is a decided advantage when it is necessary to cart off crops in bad weather. The turf persists for at least one year and makes carting easier than it otherwise would be, a fact of some importance when carting sugar beet late in the autumn on some of the fen soils.

Yields from some of these ploughed-up leys have been good during the past few years. The first crop gave yields ranging from 7 to 15 tons per acre of ware potatoes in 1950, and sugar beet ranged from 8 to 15 tons per acre, with a sugar content of between 12 and 16 per cent. Beans have given up to 10 sacks per acre. Where wheat has been the second crop, the range of yields has been between 10 and 17 sacks per acre. Some readers may be surprised at these variations, but there are big differences in the quality of the fields put down to leys, which naturally affects the yields.

From our experience the resting of land from arable crops has conferred a direct benefit on fertility and justifies a ley farming policy in the fens.

COVER CROPS IN GRASS SEED PRODUCTION

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WHEN growing herbage grasses for seed, it is usual to undersow with a cover crop to avoid the time lag which occurs when such crops are sown bare. In doing so, the yield of grass seed in the first harvest year is often disappointingly low. This is because the cover crop has been too strong a competitor to the young developing grass seedlings. Competition is a very serious factor, as has been shown by Moore(1). When examining the causes of failure in ley establishment, he found that 46 per cent of the failures were due to actual competition between the nurse crop and the ley. When plants are establishing themselves, competition for water, light and plant nutrients is acute, and the after-effect of this on the grass is shown in the yield of seed. When grasses are sown direct without a cover crop there is no such depressing effect on the yield of seed in the first harvest year. The general opinion is, however, against this method because during the seeding year the land is not producing a crop. To overcome this blank year and to make seed growing a more economical proposition, it is suggested that attempts should be made to find cover crops which will not prove too strong competitors to young developing grass seedlings. Thus more emphasis should be laid on the type of cover crop which will prove most compatible with the grass.

Characteristics of an Ideal Cover Crop If the intention is to choose a cover crop to suit the grass, we need to ask ourselves what are the characteristics of an ideal cover crop. Obviously it should be strong in the straw and able to stand up under all but the most adverse conditions, for nothing does more damage to young developing grass seedlings than a lodged crop. Moore (2), investigated the actual causes of lodging and found that 31 per cent of lodging was due to the choice of an unsuitable variety. Lodging and competition from the nurse crop accounted for 73 per cent of the failures in ley establishment (1). This emphasizes the vital part played by the cover crop in grass establishment and how important is the choice of a suitable variety. The cover crop should not possess too dense a foliage, for grass seedlings are sensitive to low light intensity, but it should be strong enough to keep out weeds. The longer the cover crop is competing with the grass, the greater must be its depressing effect ; consequently a cover crop that ripens early and uniformly should be chosen. The sooner the cover crop is removed the more time has the grass to develop into a sturdy plant and build up a strong root system for the winter. If the cover crop is late in ripening, the grass has very little time to tiller and build up root reserves, and it thus receives a check which later shows itself in reduced seed yield.

In choosing the cover crop, it should also be borne in mind that the grasses themselves vary greatly in their ability to establish themselves from seed. Some are relatively easy to establish ; with others, germination is very slow and establishment uncertain. Grasses that are easily established are Italian ryegrass, perennial ryegrass and cocksfoot. It is possible that these grasses which establish themselves quickly are not as exacting in their requirements for a cover crop as are timothy and meadow fescue, which are slower and more difficult to establish.

Tests with Timothy Timothy (S.48) was sown with a number of different cover crops in an attempt to find the most suitable. The grass and cover crops were sown in duplicate on March 16, 1948. The soil was a heavy clay, well supplied with lime. Throughout, the timothy was drilled (20 inch rows) at 5 lb. per acre, and broadcast (4 inch rows) at 10 lb. per acre. Details of the cover crops are as follows :

1. S.48 (Timothy) drilled (20 inch rows) and broadcast (4 inch rows) under Atle wheat.
2. S.48 (Timothy) drilled (20 inch rows) and broadcast (4 inch rows) under Redwing linseed.
3. S.48 (Timothy) sown in alternate drills (8 inch rows) with broad red clover under Atle wheat.
4. S.48 (Timothy) drilled (20 inch rows) with rape at 2 lb. per acre in the same drill.
5. S.48 (Timothy) drilled (20 inch rows) alone.

Observations on May 12 indicated that linseed, wheat and red clover had established themselves well, but that timothy, with and without a cover crop, was a very thin stand and germination was not complete. There appeared to be a thicker and more uniform stand of timothy under the linseed than under the wheat, which may have been due to the greater shading of the wheat foliage. Charlock was widespread throughout the area and appeared worst on the timothy drills sown without a cover crop. The linseed was cut with a binder on August 18 and the wheat on August 27. When threshed the linseed yielded 9 cwt. per acre and wheat 26 cwt. per acre.

After removal of the linseed and wheat it was possible to make a more detailed examination of the timothy and red clover. Both broadcast stands of timothy, although on the thin side, were quite uniform, but there were more weeds on the linseed area. In one series the drilled stand of timothy under wheat was cleaner and more vigorous than that under linseed, but this finding was not borne out in the duplicate series.

The drills of red clover were strong and vigorous, and the timothy between them formed a uniform stand, though lacking in density. Where S.48 had been sown in wide drills without a cover crop, charlock was widespread and for all practical purposes could be looked upon as an unsown cover crop. On June 14, when in full bloom, the charlock was topped over with the mower and removed. This stand of timothy was the most vigorous and uniform.

By May 12, the rape had established itself into a strong plant and the timothy looked very thin by comparison. Charlock was again a very troublesome weed, covering most of the area. The rape was first grazed by sheep during July and then topped over with the mower to control the charlock. In September the rape was grazed again and the sheep given access to all the timothy stands. By this time the timothy had tillered and looked a much denser stand. In the first harvest year all the timothy stands were put up for seed, except the timothy sown in alternate drills with red clover. The aim with this method of sowing is to take a seed crop of red clover in the first harvest year, followed by timothy seed in subsequent years, as the red clover, being biennial, will have died out after the first year. As red clover was a stronger and much more forward plant than the timothy, this plan was adhered to, and after cutting for hay in early June, a seed crop of red clover was taken in September, 1949. This will be followed by a seed crop of timothy in 1950.

When the timothy was cut for seed in September, 1949, the experimental block was harvested as one unit. The yields from each treatment were estimated on the basis of the actual seed yields obtained from other plots within the area.

Despite the September grazing, the rape overwintered and ran to seed in the spring of 1949. It was cut back on April 27, so that it was not possible to make a direct comparison of the timothy undersown in rape with the other treatments. If rape is allowed to seed in its second year it is not suitable as a cover crop.

The S.48 (Timothy) drills sown without a cover crop looked like giving the greatest yield, but this had partially lodged and there was some loss of seed. Owing to the lodging it was not possible to make an accurate estimation of the yield of seed.

More Seed from Drilled Stands Where linseed had been sown as a cover crop the timothy stands were decidedly more weedy than those which were undersown in wheat. The yield from the drilled stand was estimated at 5 cwt. per acre of clean seed and that from the broadcast at 3½ cwt. per acre or about two-thirds of the yield obtained from the drills. Linseed is suitable for a cover crop where the land is clean, or where the timothy is sown in widely spaced drills, as the weeds can be controlled by inter-row cultivation after the linseed is harvested in the seeding year.

The timothy stands undersown in wheat were much cleaner, although not so dense as those undersown in linseed. There was no discernible difference in the yield of seed from the timothy under the two cover crops.

In the broadcast stands of timothy the seed heads were much smaller and the plants were not as vigorous as those from the drills. The higher estimated yield of seed from the drills and the better control of weeds by inter-row cultivation indicates that a widely spaced crop of timothy for seed is to be preferred to that of a broadcast stand.

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A MIXED FARM IN SOUTH ESSEX

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HEATH PLACE, Orsett (265 acres), farmed by Mr. M. B. Watt, is situated in South Essex, just north of the Thames Estuary. The feature of the farming in this area is the production of vegetables and early potatoes, together with ley farming and the keeping of dairy cows. Mr. M. B. Watt's system of farming is of particular interest because the land is on a light Valley Gravel formation with an annual average rainfall of under 19 inches, yet the crop production compares very favourably with farms in the district on the rich brickearth soils. He has overcome the shortage of feedingstuffs by sowing down special-purpose leys, supplemented by silage and tripod hay. Recently Mr. Watt has developed a unique system of outdoor pig-keeping for folding off the old lucerne mixtures before they are ploughed up.

How very different were the conditions in 1889, when Mr. Watt's grandfather came down from Ayrshire to take over the farm in a derelict condition ! In company with a farmer friend on a similar errand, he travelled by special train, bringing with him his implements and livestock. Corn production was tried, but little progress was made until the farm was turned over to dairying. Eventually quite a large herd was kept, on which Professor Boutflour carried out many of his earlier trials on the management and feeding of dairy cows. During its history the farm has weathered many depressions. At the present time the system is very flexible, a large variety of cash crops are sold off, and returns from livestock provide a comparatively steady and regular income.

Rotation of Crops The rotation of crops, spread over eleven years, is four-year ley, followed by winter oats, potatoes, cabbage, vegetables, wheat, oats, potatoes, cabbage, and mustard. Sometimes the ley is followed by potatoes, and potatoes by fallow and mustard for winter wheat. Although the soil is naturally very well drained, under continuous cultivation it tends to form an impervious plough pan, and to counteract this the land is subsoiled regularly at the end of the ley period by drawing a mole plough every 4 feet to a depth of 2 feet or more.

This type of land requires very careful management ; if too many straw crops are taken and not enough humus is returned, it quickly loses its texture and moisture. Mr. Watt has found that under these conditions the best results are obtained by the moderate use of fertilizers, and for the vegetable crops he prefers the bulk of the nitrogen to be applied in an organic form.

The most important cash crop grown is early potatoes, and when planted after cereals they receive 15 tons of well-rotted farmyard manure and 12-14 cwt. of an NPK compound per acre. Once-grown Home Guard potatoes are cropped with a few Ninetyfold for early lifting. The seed is trayed immediately after lifting and stored in the chitting houses, the idea being to control sprouting and to preserve the first shoots. Planting is done at the beginning of March, and the crop is ready for lifting at the beginning of June. Once-grown seed is favoured because the crop is earlier and of better quality.

Half the potato acreage is followed by spring cabbage for cutting in January onwards. January King is sown during the second week of June to give the first cut. It is drilled at 24 inches and later cross-blocked and

singled at 24 inches. Spring Cabbage No. 218, is sown during the first week of August for cutting in April onwards. Both these sowings are in 22-inch drills. The spring cabbage is sown in wide drills for cultivation and cleaning by a tractor tool-bar. Another advantage is that after the first cutting the remaining crop hearts up quicker. All the vegetable crops receive a dressing of 6 cwt. per acre of compound fertilizer. As the land is in an excellent state of cultivation, there is little difficulty in preparing a satisfactory seedbed at any time of the year, and despite the very low rainfall, the cabbage crops are generally showing above ground within four days of sowing. Any food left over is folded off with sheep brought in from a neighbouring farm. Usually the spring cabbage is followed by runner beans and marrows, thus producing three crops off the same land in two years.

Very satisfactory crops of cereals are grown on these light dry soils. Essex Pearl wheat is used for winter sowing and Atle for spring cultivation. Winter oats S.147 and spring mixed corn crops are sown for feeding to livestock, together with Pioneer barley for pig-feeding. Excellent samples of malting barley can be grown and yields of up to 7 quarters per acre are obtained.

All the cutting is done by binder, and the cereal crops are dried and matured on tripods. These tripods consist of three poles, each 7 feet long which are secured at the bottom by a length of wire about 2 feet from the ground, and at the top by a tier made from whatever crop is being harvested. The tripods are set up in lines across the field, about 8 to 12 tripods to an acre of cereals, and up to 70 sheaves can be built on to each. Barley and wheat can be set up immediately after cutting, but oats are best left for two days to wilt. Two stacking gangs are kept going by one man gathering with a tractor sweep. On tripods the crop is absolutely safe from the weather ; the corn and straw is always of excellent quality and the oat straw is particularly suitable for feeding. Mr. Watt's theory is that once a crop has been cut, it is damaged as much by the sun as by rain.

Ley Farming The four-year leys have been an outstanding feature of the farm for a long time, and all sorts of mixtures and methods of establishment have been tried to perfect the present system. Only special-purpose mixtures are used, and to ensure a good take they are sown without a nurse crop after a green crop has been ploughed in. The land to be sown down is cleared of cabbages or other spring crop and then ploughed and limed at the rate of 2 tons per acre of carbonate of lime. About June 1, a crop of mustard is sown and when at the correct stage (about 18 inches high and just before flowering), it is ploughed well under. The land is worked down and the seeds are drilled immediately, about July 1

Grazing Mixture	*lb. per acre*
Meadow fescue	7
Timothy S.48	6
Cocksfoot S.37	5
White clover S.100	3
	21 plus ½ bushel of rye

The rye is added to the mixture when necessary for the provision of very early grazing and a particularly early bite in the spring. Normally 4 cwt. compound fertilizer are applied, but after a dry season no manures are given at the time of seeding. Established leys are treated with 3 cwt. super per acre in the autumn, and with 2 cwt. nitrogen in early spring. The new leys are grazed from eight weeks after sowing up to the end of November.

when they are shut up for the winter. In the spring the pasture is divided up for rotational grazing, and the plots are arranged so that they radiate from some convenient water supply, one tank being used for four enclosures. Mr. Watt has doubled his pasture production by the introduction of rotational grazing, and a 26-acre ley produces ample grazing for the dairy herd, and during the spring and early summer it carries the dry cows and young stock.

Hay and Grazing Mixture	*lb. per acre*
Lucerne (*Provence*)	16
Cocksfoot S.26	5
	21

This mixture is sown down as mentioned above, except that no rye is included, and the manuring consists of 5 cwt. super and 2 cwt. muriate of potash per acre. No nitrogen is applied, since this tends to encourage weeds. If the lucerne is very forward at the end of the season, with secondary tillers at the base of the plant, a cut for hay or silage is taken, which has the effect of strengthening and thickening the stand. Mr. Watt prefers mixtures to lucerne alone ; they make better quality hay and provide more suitable aftermath grazing for young stock.

Mr. Watt is confident that it would pay him to make all his hay on tripods. The hay made on tripods this year, despite the weather, is of excellent quality, sweet smelling and almost as green as when it was cut. The tripods are used as for corn, the mixture being cut dry and as soon as possible windrowed and swept to the tripods. A tripod will make about 6 cwt. of hay, and when being built, cages are placed at the corners and afterwards withdrawn for ventilation.

Silage and Hay Mixture	*lb. per acre*
Lucerne (*Provence*)	16
Milled giant sainfoin	10
Timothy S.48	2
White clover S.100	½
	28½

Timothy is used in this mixture because it is not so vigorous as cocksfoot, and a well-balanced sward can be maintained for a number of years. The silage cut is taken first, as the Giant Sainfoin is rather woody for haying at this time of year, and the work fits in conveniently with other operations on the farm. A large pit silo has been dug in the middle of a block of land, so that short hauls can be made from four or five fields. This year 140 tons of high quality silage were made from 19 acres of mixture. All the gathering was done by a buckrake, with an extra man working at the pit, spreading the crop and sprinkling the molasses. This high quality silage with a crude protein content of 19 per cent has been made at the low cost of 19s. 1d. per ton, a figure which covers the total cost of growing and clamping, after allowance has been made for the hay taken from the same field.

Dairy Farming The Shorthorn herd has been carefully upgraded and is now pedigree and attested, with a high average milk yield. Since 1940, when tuberculin testing was started, the policy has been to keep a smaller self-contained herd of about 30 heavy yielding cows and their followers. Grading-up was started in 1921, and since 1928 the herd has been line bred to the Dairy Chain family in the Revels herd, belonging to Mr. W. H. Vigus of Bengeo, Hertford. The object has been to breed a good type

of cow, with depth and capacity for dealing with large quantities of home-grown food and, at the same time, to be capable of producing an average of 900 gallons of milk, with good fat percentage, and breeding a calf every year. Except for a few Class "D" cows, the whole herd is now pedigree, and herd averages up to 970 gallons have been recorded.

In establishing an attested herd, Mr. Watt was less fortunate, in that on two occasions some of the milking herd failed on re-test, but the young stock remained clear. His next step was to isolate the milking herd and after a rest period at his home farm, to establish a small attested herd with 8 home-bred down-calving heifers. To build up the milking stock quickly, he took the calves from the reacting herd and reared them in isolation. This method was entirely satisfactory, and there have since been no reactors ; seven of the original 8 down-calving heifers are still in the milking herd and, on the whole, the stock has been much freer from disease. About 14 calves are reared yearly, but only 7 or 8 down-calves are brought into the herd each autumn. The surplus stock is sold at Reading, and all the bull calves are steered and sold locally for fattening.

The calves are reared on the bucket in separate pens and are fed whole milk for at least eight weeks. A pint of warm water is mixed with the milk to prevent scour, and after weaning the calves are fed on 5–6 lb. of hay with oat straw and 2 lb. of meal. To avoid any check in growth, the calves are not turned out to pasture during their first year. The results are very satisfactory ; the animals are well grown with excellent weight for age, and Mr. Watt considers that the extra cost is well worth while. All the young stock are wintered in the open yard with shelter provided, and fed 20–30 lb. of silage, 8 lb. of hay or oat straw, and 2 lb. of meal.

The cows, which are wintered in yards from the middle of October to the end of March, are fed on home-grown foods, consisting of 40–45 lb. of silage, 8 lb. of hay and oat straw, for maintenance and the production of 1½ gallons of milk. For extra milk production they are fed 4 lb. per gallon of a meal mixture made up of 1 part beans and 4 parts oats and purchased concentrates. The silage is fed outside, and the other foods are given in the cowshed ; there is no feeding in the yards. The cows settle down quietly, and so far there has been no need to dehorn the stock.

The average milk yielded last year was 9,464½ lb. in 305 days, and some of the highest individual yields were :
Heath Place Lily 7th—14,565½ lb. in 305 days with her fifth calf.
Heath Place Hilda 17—13,325 lb. in 305 days with her fourth calf.

The stock bull used at present is Heath Place Grand Atom out of Revels Daisy 4th, which gave an average of 10,650 lb. for five lactations. The sire's dam was Revels Gentle, with an average of 11,334 lb. for three lactations. In 1949 the Matthews Cup was won for the best Shorthorn herd in Essex. The young stock were placed third.

Quite apart from the milking value of the herd, the yard manure is of considerable importance for the arable side of Mr. Watt's farm. All the straw from the cornbreak, supplemented by 100–150 tons of purchased material, is used for bedding, and at the end of the winter feeding period the yards are 3–4 feet deep with litter. This is then turned, by grab, and allowed to rot down and mature.

Open Air System of Pig-Keeping The pigs on the holding are a comparatively recent innovation, and were started when the Minister of Agriculture was appealing for a pig on every farm. The original idea was to keep 6 sows and to fatten 100 baconers a year on the old lucerne leys,

so adding a little more fertility to the land. The open air system was an immediate success, and the numbers of pigs were rapidly increased. All the sows are pedigree Essex, and lately a Large White boar has been used for crossing to produce a better baconer. The Essex sows are particularly good mothers, and they take kindly to an outside existence. The sows are kept in paddocks of ¼ acre by electric fencing, using smooth wire ; barbed wire is unnecessary. Only one litter is reared on the same land, and although the pigs are very healthy, precaution is taken to have the sows immunized against swine fever and tested for T.B., while the baconers are inoculated with crystal violet vaccine.

The farrowing huts are home-made and very simple. The floor space is 9 feet by 8 feet, with a door at the front and a small inspection hatch at the back that can be opened in summer for ventilation. The roof is of super-six corrugated asbestos sheeting, and slopes from the floor level to the ridge. For warmth, the roof is boarded on the inside from the floor up to 18 inches, and a bag is hung over the door in winter. Extra heating is given at farrowing time during the winter until the pigs are seven days old. A simple gas jet is used with a protection of sheet metal which deflects the heat downwards ; there is a guard round the burner, and the arrangement appears to be satisfactory. The low slope of the roof provides a warm place for the young pigs out of the way of the sow, and farrowing rails are not required. There has been no difficulty with rearing in January, and for the winter months, litter averages have been well up to standard. The little pigs wander about from pen to pen, as they can easily creep under the electric fencing, and they obtain all the extra food they require from the communal trough which is placed in the alley way. Since National Pig Starter has been used, the weaning weights have been up to 40–45 lb. at eight weeks. This is very important, as for every 1 lb. increase in live weight at weaning time, there is a corresponding shortening of the fattening period for baconers of about 2½ days, an increase from 30 to 40 lb. reducing the period by three weeks. The sows are fed twice daily, with a mixture containing 10 per cent protein-rich food and minerals, and during the dry period they are run together in a small wood.

The fattening pens are 20 feet square and made of surplus steel scaffolding. A hut 9 feet by 8 feet and a 40-gallon tank with a drinking bowl are attached to the pen, which is on wheels. The pens are moved every two days and the pigs are tended once a day. The pigs are fed dry, using self-feeders, and they help themselves to water and green food. This is not only a cheap and labour-saving method of pig-keeping, but the feeding is very economical. The pigs are being fattened to bacon weight, 200 lb. live weight at 24–26 weeks old, with a meal conversion rate of less than 4 to 1. The pigs are started off at eight weeks on a daily ration of about 2½ lb. of meal, and this is gradually increased to 4–4½ lb. by the end of the fattening period. If the pigs were indoors at least an extra 2 lb. of meal daily would be required at this stage, so that the pigs must be eating 15 lb. of green food per day. The fattening meal mixture is made up mostly of home-grown foods with only 2½ per cent high protein food, as follows :

Fattening Mixture for Pigs on Lucerne	*per cent*
Barley meal	40
Wheat and maize products	40
Oats	15
High protein food	2½
Minerals	2½

The success of Mr. Watt's farming is undoubtedly due to the use he has made of modern methods of production. Yet there is still an air of tradition about the place, and most of the eight regular employees have worked on the holding from the time they left school. There are mess rooms, and the farm cottages are being improved with the installation of electricity and hot water systems. Bonuses are paid on milk yields and calvings, and the rates are varied to encourage calvings at the right time. With other sections of the farming, bonuses are paid at Mr. Watt's discretion on the profitability of the crop. So that every man knows his own tools and those which belong to the general store, each set of tools is marked with a distinctive band of paint.

A description of the activities on this farm would be incomplete without reference to the harvest supper, which is an occasion in the district when all the employees and people connected with the farm gather for an evening's enjoyment.

HILL CATTLE IN THE NORTH

W. Lyle Stewart, M.R.C.V.S.

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IN pre-war Britain the annual consumption of meat per head was around 130 lb., of which more than half was high-class beef, mutton, etc. imported from overseas. Early in the war, meat imports were drastically cut, but in 1950, five years after the conclusion of hostilities, there is still a considerable meat shortage, and the present consumption per head has now fallen below the war-time ration. This, of course, is due to entirely different causes. It is no longer related to available shipping space, but rather to Britain's post-war economic position and to the continuing difficulty of obtaining supplies from American countries, e.g., Argentina and Uruguay. Devaluation of sterling accentuates this unfavourable purchasing trend, but has the merit of stimulating interest in the home-produced article. No one doubts that the volume of internal meat supplies could be stepped-up, and there has been much current discussion about cattle "ranching" in deer forests, sheep walks and on marginal lands, and indeed, considering the popularity of dairying in the more accessible lowlands, any notable expansion in beef must call for a greater contribution of suitable stores from hill and marginal areas, much of which is at present comparatively unproductive.

The traditional but fluctuating role of hill cattle in Border farming seemed to call for a closer study and understanding of this type of husbandry. Can the number of hill cattle be increased? What are the snags and disadvantages of cattle? Do cattle really benefit the sheep or are they harmful? In discussing hill cattle, many queries of this type arise. With the object of clarifying these points, information has been collected on the management, health, fertility, etc. from fifty hill and marginal farms, all with breeding herds, mostly of Galloway cows. An account of this survey has already been published,* wherein reference was made to the poor breeding records

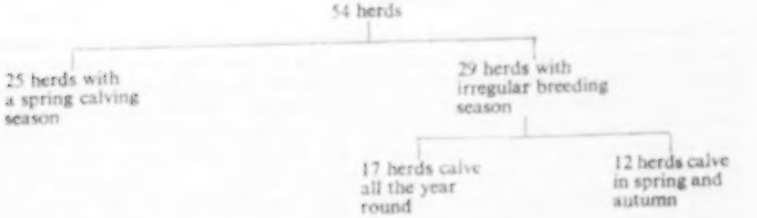
*W. Lyle Stewart. The Duke's Fund Report, 1948. Fourteenth Report of the Trustees.

of many herds. Calf production figures of 60 per cent were quoted; most cows bred irregularly, and temporary infertility was, it seemed, the rule rather than the exception. So far as could be ascertained, on most farms this laggard breeding was not caused by infectious disease but was presumably related to anoestrum, or failure to come into breeding use. It is a matter for speculation how much of this wastage was due to faulty nutrition.

Thirty years ago veterinary workers in South Africa discovered that low productivity in cattle grazing on the South African veld was due primarily to phosphate deficiency. Among other things, this led to slow development, lameness, long intervals between breeding (or complete anoestrum), and loss of appetite, and to an abnormal craving for bones and carcass debris. These symptoms could be abolished entirely by feeding bone meal, and this simple adjustment in cattle husbandry in South Africa transformed a very moderate cattle country into a very good one. Since that time, the primary importance of the element phosphorus in animal nutrition has been amply confirmed in all the principal cattle countries of the world, and, in addition, these investigations have uncovered other mineral deficiences such as copper and cobalt, which have a profoundly adverse effect on productivity. Naturally in Britain's more equable climate, the extreme manifestations of deficiency diseases such as occur on the arid veld are not expected, but the Newcastle experiments with sheep showed clearly that these animals often live under such conditions of mineral deficiency as constitute a definite though unseen barrier to production. It was in the hope of obtaining more information on these points that the hill cattle survey was continued until 1950, and the following summarizes some of the data obtained.

The Survey Extended Information was obtained from 54 farms (predominantly sheep farms) each with a number of cattle, chiefly Galloway cows. The herds are mostly of 10–30 cows, and 37 are bred with the Galloway bull; the remainder are bred with the Shorthorn bull to produce the popular blue-grey calves. The cows are outwintered in 35 herds, and inwintered in 19. These cows lie out throughout the year if provided with some natural or artificial shelter and with hay during the winter; where accommodation is available (which is seldom), farmers prefer to winter the cows inside, on the grounds that it is more convenient and the dung is then available for arable or meadow use. Foddering, mainly with home-grown hay and bought oat straw, starts in December and continues until May. Mineral supplements of one kind or another were fed in unknown amounts in 27 herds in 1949. In the past there has been no official ration of concentrates for hill cows, but some of this feed is occasionally diverted from the ewes; also small amounts of home-grown oats may be fed, although this seldom happens before calving. Table 1 summarizes the breeding arrangements:

Table 1



This shows that in no less than 29 herds a spring calving season is dispensed with, and in the majority of them calvings occur throughout the year. To a large extent, this arrangement implies a lack of system and is really a spring calving season gone wrong. It usually starts with a few late-calving cows or the failure of some cows to attain breeding condition by August when the bulls should be withdrawn. In this predicament, the farmer decides that a late calf is better than no calf, so the bull stays longer or may even accompany the cows throughout the year. Ten herds specialize in spring and autumn calvings to cater for a local trade in cream. These are mainly small farms with adequate labour, and despite the use of Galloway cows, this system is really a compromise between dairy farming and hill farming. Good store bullocks are produced on these farms and sell well at 18-24 months.

A spring calving season is desirable in many ways. By arranging for the calves to be born, say, from March till June, the bulk of the herd can be turned out to the rough grazings in May; newly-calved Galloway cows are more efficient grazers than any other class of stock, and the calves receive the maximum benefit from the spring flush of milk. Finally, a spring calving season entails least labour, since the herd requires only occasional supervision, and the major operations of castration and weaning can be done at fixed times.

Better Feeding to Prevent Disease Hill cattle are healthy, long-lived and notably free from the major bovine infectious diseases, namely, tuberculosis, contagious abortion, mastitis and Johne's disease. It is considered, however, that there is perhaps too much complacency about the risks from contagious abortion in hill cattle herds and too little appreciation of the value of preventive measures. The history from nine herds was suggestive of this disease. Vaccination with S.19, mostly after poor calf crops, was noted in twelve herds, whereas vaccination is a preventive measure specially intended to obviate such a state of affairs.

Lactation tetany, a disease also known as hypomagnasaemic tetany, was frequently reported. It causes the sudden onset of tetany and convulsions, accompanied by a sharp reduction in blood magnesium, and affects cows several weeks or more after calving. This disease is probably of dietetic origin. The data obtained suggest that susceptibility to lactation tetany is related to poorish condition in the spring. Many farmers are trying to prevent the disease by stepping-up winter nutrition in one or other of the following ways:

1. By feeding roots or silage.
2. By feeding concentrates.
3. By restricting spring grazing until there is a full bite.
4. By the use of mineral supplements.

These practices are designed to improve winter nutrition and to smooth out the transition from a semi-starvation diet of poor hay to a flush of spring grass. The data collected indicate the value of these measures, and indeed, they have a thoroughly sound physiological basis. For example, no reports of lactation tetany were obtained from the comparatively better fed autumn- and winter-calving cows. Judging by the interest displayed in this disease, it is probably true to regard it as a limiting factor to an expansion of hill cattle enterprises, since many farmers may be unwilling to risk the capital losses which lactation tetany involves. The disease runs a short course and

ends fatally unless immediate veterinary help is obtained. Curative treatment is reasonably effective, but often cannot be given in time. Since the cost of wintering cows is an integral part of the picture, farmers are optimistic with regard to the specific preventive effects of mineral supplements, and especially those containing magnesium. There is need for more precise information on this point, but in general the results are encouraging.

Since much of the Border uplands is tick-infested, the two diseases of louping-ill and redwater commonly occur in cattle. Records were obtained of twelve cases of redwater in three years, of which seven died. In the same period seventeen cases of louping-ill were recorded, of which three died; consequently redwater is regarded as the more serious disease. Cattle are frequently vaccinated against louping-ill, but there is no such insurance against redwater, which is more common for newly-bought, unacclimatized stock.

Other diseases reported were impaction of the stomach with dry fibrous herbage, which occasionally occurs in springtime; most cases respond to treatment. The survey yielded very little information about liver rot in cattle, but veterinary surgeons state that many hill cows are affected with the parasite, and abattoir figures show a high proportion of livers condemned from this cause. While routine dosing against liver rot is regularly employed to protect the sheep on many of these farms, it is curious that in no single farm is this practice adopted with cattle. Calf mortality in the hill herds was extremely low. The cows generally calve out of doors and calf scours are uncommon.

Spring Calving gives Better Results The best calf crops were obtained from the spring-calving herds, average figures being around 75 to 85 per cent. Few herds were below 70 per cent. The poorest figures, 70 to 80 per cent, come from herds calving all the year round, but these figures are not so reliable, owing to the possibility of confusion in the calendar years. In general, cows calving before July have a better chance of conceiving without loss of time than those which calve later in the year. Table 2 illustrates this point, and provides a further reason for adhering to a spring calving season.

Table 2

Herd 40. All Calvings in the Eleven Years 1939-49

Period	Number of cows calved	Percentage	Number of cows barren the following year
Jan.—Mar.	43	36	3
Apr.—June	42	35	3
July—Sept.	16	13	4
Oct.—Dec.	20	16	11

The Galloway is one of the oldest and hardiest of all British breeds of cattle. They are traditionally mountain or hill cattle and, if attuned to their upland environment and well managed, they should be reasonably productive, but compared with the hill ewes, barrenness in hill cows is proportionately greater. Admittedly these cows are less hardy than the sheep, and their wintering requirements are higher. Normally the sheep receive no hay during winter, and the rate of barrenness is generally stated to be about 5 per cent. The cows, on the other hand, always receive home-grown hay,

and on this feed they frequently suffer much loss in condition which they hardly make up until late in the following summer. The impression is, therefore, that poor wintering induces anoestrum.

The number of cows kept on a hill farm is proportional to the acreage of meadowland, and bears no exact relationship to the total size of the farm. Shortage of winter keep is an obvious limiting factor, and it is of interest to inquire if this nutritional barrier is of a general or specific nature.

In order to study the general nutrition of these cows during winter, an assessment was made of the daily intake of protein and energy in 12 herds. Hay samples were analysed and estimates made of their starch and protein values. The maintenance requirements for 10-cwt. animals may be expressed as 6.5 lb. S.E. and 0.65 lb. P.E. By adding one production unit for the calf, the theoretical daily requirement becomes 9.0 lb. S.E. and 1.25 lb. P.E. per cow.

The result of this study goes to show that the estimated starch and protein values of the winter feed frequently did not meet these theoretical requirements. Ten of the sixteen rations examined were deficient in net calories, the protein being notably low. It is therefore quite possible that a protein deficiency contributes to the observed anoestrum. The position is complicated, however, since feeds low in protein are also commonly low in minerals.

Calcium and phosphorus are two elements which exert a specific effect on mammalian reproduction, and an attempt was therefore made to assess the calcium and phosphorus status of the winter diet. An accurate approach to this aspect of the problem is rendered rather difficult for several reasons; for example, unknown amounts of lime find their way into the animal through the drinking water, and there is a dearth of firm figures for the phosphorus requirement of a beef cow producing and rearing one calf. This figure, however, probably lies around 15 grammes or half an ounce daily. Samples of hay were analysed for their mineral content, and from the amount fed daily it was possible to calculate the approximate intake of both calcium and phosphorus. These figures are reproduced in Table 3.

Some caution is necessary in drawing conclusions from these figures, but those for phosphorus are frequently lower than arbitrary requirements. In addition, the ratio of calcium to phosphorus in nearly half these figures is too wide, and at these comparatively low levels of intake may have a significant bearing on the observed infertility.

Table 3 Eight Herds

Daily Calcium and Phosphorus Intakes (*in grammes*)

Herd	Calcium	Phosphorus	Ratio of Calcium to Phosphorus
4	64.2	27.0	2.4 : 1
4	72.8	32.7	2.2 : 1
6	57.1	28.0	2.0 : 1
29	80.6	31.6	2.5 : 1
39	102.9	20.0	5 : 1
39	100.2	20.5	5 : 1
39	92.8	22.6	4.5 : 1
41	49.2	12.8	4 : 1
48	32.8	13.6	2.4 : 1
48	54.9	13.6	4 : 1
54	80.6	20.5	4 : 1

Use of Mineral Supplements Records were also kept on the effect of feeding complete mineral supplements to hill cows during winter and spring. These feeding trials began in 1947-48 in fourteen herds, and little difficulty was experienced in getting cows to consume 1-3 oz. daily. Farmers consider that this addition benefits the cows and their calves, but it is still too early to assess their specific effect on fertility, although the indications on several farms are encouraging. Viewed broadly in the light of the data obtained during the survey, there is every reason to expect considerable benefit from feeding a mineral mixture composed principally of feeding bone meal and trace elements. The use of ground limestone would appear to be contra-indicated, but the addition of magnesium is advisable on account of its probable role in preventing lactation tetany.

Hill cattle of the hardy type are the ideal co-partners of sheep in hill farming, and no evidence was obtained of cattle having a harmful effect upon the sheep. On the contrary, the evidence points in the other direction, and many hill farms could be made healthier and more productive in every way by the presence of a herd of hardy cows. Shortage of winter keep is the biggest barrier to expansion of the cattle enterprise, and it is probable that many herds overwinter on too low a nutritional plane. This bottle-neck should be by-passed in every possible way—by improving existing meadows and making new ones, by the making of silage, and by the provision of shelter and buildings for inwintering. Inwintering implies a more intensive form of husbandry and should be encouraged. More exact knowledge is needed as to how diseases peculiar to these hill cows can best be combatted.

It is a pleasure to acknowledge the help received from Mr. E. Cresswell, B.Sc., Mr. H. Hayes, B.Sc. and Mr. Norman Trinder, M.Sc. The two first-named gathered most of the data, and Mr. Trinder undertook the chemical analyses of the feeds.

COED Y BRENIN

The story of the formation of the State forest of Coed y Brenin (or King's Forest), which lies in the heart of the "wild and mountainous county of Merioneth," is told in a booklet published by the Forestry Commission and obtainable from H.M. Stationery Office, or through any bookseller, price 6d. (7d. by post). Both English and Welsh editions are available. The Forest, which received its name in commemoration of the Silver Jubilee of King George V, covers about 26 square miles, and the scenery has been compared to that of Switzerland and the Tyrol. The relatively new plantations made by the Forestry Commission since 1922, are now so mature that they give the impression of natural forest. Already the forest has produced telegraph poles and great quantities of pit props. Some 120 people are employed and there are 42 forest holdings.

CATTLE GRIDS

CLAUDE W. BRIGHTEN, O.B.E., F.R.I.C.S., F.L.A.S.

THERE are few less costly devices that give such widespread value to the general public and agriculture, as cattle grids. Their adoption on all classes of public highways, hill farms and gated roads, private drives and farm roads, is an inestimable service and a convenience for all kinds of traffic. The Highway Act of 1835 hitherto prevented grids being placed in our highways, but this has now been remedied by the Highway (Provisions of Cattle Grids) Act, 1950.

For the past twenty years I have constructed my own design of cattle grids on private drives of four different estates, and in no case has any quadruped, not excepting deer, ever crossed or been injured in a grid. This can also be said of the grid at Forest Gate, Windsor Great Park, which, owing to the transfer of the deer to Richmond Park, has now been removed.

Recent costings of the rolled steel joists on reinforced concrete sleeper walls, have been found to be no higher than the original type constructed of second-hand railway sleepers and steel tubing. I am completely satisfied that this type of grid is suitable for every class of private road.

The following basic facts and measurements are recommended :

Concrete foundations to sleeper walls should be 15 inches × 6 inches and should be reinforced.

Reinforced concrete sleeper walls should be 6 inches at the base and taper to 4 inches, with splayed top where they embrace the rolled steel joists. The reinforcement should be brought up and hooked on to the lower flanges of the rolled steel joists.

Bars should be made of 3-inch × 1½-inch rolled steel joists.

Two coats of black bitumastic paint should be applied before fixing.

Spacing between the edges of rolled steel joists should not be less than 6 inches. This enables leaves and other rubbish to be cleared away easily by standing on the bottom of the pit. It is quite unnecessary, in my opinion, to have any of the bars removable ; the whole grid should be constructed in one piece.

Depth of pit should be between 12 and 18 inches.

Drainage should consist of 4-inch pipes in each corner of the containing walls of the grid ; the bottom of the grid, between the foundation walls, should be left unconcreted.

Side fences should be independent of the grid but not higher than 3½ feet. They should be on oak posts thoroughly preserved, charred or tarred at the base, and the top and bottom oak rails with panels filled with best quality interlocking chain-link fencing. Concrete posts are not recommended since, if they receive a sudden blow, they are likely to snap like a carrot.

The weight of vehicles passing over the grid can be unlimited.

General. Views differ greatly as to the best spacing of the cross members, but years of experience have shown that 6 inches is the ideal. When approaching the grid from a low angle, this spacing emphasizes the shadows of the grid pit at a greater distance and is more effective as a visual barrier. Cyclists pass over a 6-inch spacing without any vibration or jarring.

Expense can also be saved on gated roads by erecting the grid as a by-pass and leaving the existing gateway in position. Where footpath and bridle road rights exist, only a field gate need be provided. Though kissing gates have been erected in the past where public footpath rights exist, it has been found in practice that the public prefer to walk across the 6-inch spaced grid.

This they do at their own risk if a gate has been provided for their use. Tractor-motor-propelled vehicles, horse-drawn vehicles, equestrians and the Hunt must use the by-pass gateway.

It is essential for the width of a grid on a road to correspond with that of the carriageway ; any narrowing of the road at the grid is undesirable and dangerous, especially in a fog.

Given the will and the intention, grids can be constructed with maximum efficiency at very low cost. Their direct assistance to agriculture is incalculable, both from the viewpoint of fuller grazing of our wastes, commons and hill farms, to say nothing of the better temper and convenience of all living on the land. Wherever there is a farm road with a gate across it, there can a cattle grid always be substituted.

A leaflet on Cattle Grids (Fixed Equipment of the Farm No. 7) is obtainable free of charge from the Ministry of Agriculture, 36 Chester Terrace, Regent's Park, London, N.W.1.

WINTERING STORE CATTLE

COCKLE PARK TRIAL, 1949-50

PROFESSOR H. C. PAWSON, M.B.E., M.Sc.
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THE feeding trial described in this article was conducted, as in the two previous years,* with 41 animals, made up of two lots of ten bullocks and three lots of seven heifers. All the animals were out of our breeding herd of attested Beef Shorthorns, from the same dams and sired by the same pedigree Shorthorn Bull (Cruggleton Ratio, 328423) and reared in the same manner. (This bull, incidentally, has now been sold and replaced by the Cruggleton Burke, secured at Perth sale early in 1950.) The calves were born in the spring of 1949, were suckled by their dams and weaned in October. After a short preliminary period on winter rations, the actual trial began in November. From then onwards the cattle were weighed at monthly intervals.

The table (p. 470) giving comparative results for the three winters shows that the gains for 1949–50 were not as high as those in the previous winter, but correspond closely to those of 1947–48. The rations were the same as for the previous winters, as also were the arrangements for accommodation and for the grazing of the outwintered cattle. The major difference was in the quality of the silage. The report on the silage fed in the winter 1948–49, received from the N.A.A.S. showed 16.56 per cent crude protein and also stated that " it contains more protein than fattening or store cattle require". For 1949–50 the material used was grass which had reached a more mature stage, being the first cut of the season, as distinct from the aftermath of a ley used in 1948, and had 11.29 per cent crude protein. The same pit silo as for 1948 was used, situated at the steading. No molasses or other materials were added to the grass.

*Accounts of similar trials for 1947–48 and 1948–49 were published in the November, 1948, and January, 1950, issues of *Agriculture*.

WINTERING STORE CATTLE AT COCKLE PARK

The following is the report on the analysis of the grass silage, made by my colleague, Mr. Brynmor Thomas, Reader in Agricultural Chemistry at King's College :

> The silage received from Cockle Park proved to have a dry matter content of 18.9 per cent and a *p*H. of 3.98. The crude protein content calculated on a dry matter basis, was 11.29 per cent.
>
> The ensiled material appeared to have contained a fair amount of cocksfoot with more or less of the ryegrasses, meadow-grasses and sweet vernal. The grasses were at the flowering stage, and the clover in early flower. By and large, the material was somewhat mature, and this is reflected in the relatively low protein content.
>
> Fermentation had been satisfactory—as indicated by the *p*H. figure—and the sample was of the light brown acid type ; hence the digestibility co-efficients of the organic matter and its constituents should be fairly good.

As in the previous winter, the silage-fed animals did not carry the same bloom at the end of the winter as did those receiving the linseed cake. The two lots were valued by the independent valuer in April, 1950 at £27 and £30 per head respectively. The home-grown mixture of beans and oats, whilst not giving quite as good gains as in previous years, gave very satisfactory increases. It should be remembered that Lot V has consisted of the younger and, therefore, smaller animals.

The silage ration has been criticized on the ground of its lower dry matter and starch equivalent, as compared with the other rations. More silage had been offered with the intention of finding out if the animals would clean up satisfactorily a larger quantity, but 20 lb. per head appeared to satisfy their requirements. For this winter (1950–51) we are giving the silage lot the same quantity of hay as the other two lots (i.e., increasing from 8 to 10 lb.) and are trying again to encourage the animals to eat more silage, commencing in the preliminary period, in the hope that they will take 25 or 30 lb. per head for this trial. This larger quantity, along with 10 lb. hay and 1½ lb. oats, will complete their ration, and on this basis they will then receive quite as much dry matter and starch and protein equivalents as the other two lots of heifers.

The outwintered bullocks were valued by the same valuers at £30, and those wintered indoors at £28 per head though, as will be seen from the table, the latter were considerably heavier when valued in April, 1950. This confirms the old saying that, " In the spring hair is worth more than weight." Both lots of bullocks were summered in 1950 on slag-improved old grass at Cockle Park and, when weighed on August 21, those wintered outdoors averaged 1 cwt. 36 lb. increase per head, and those wintered indoors 1 cwt. 64 lb. (i.e., from May 15). The corresponding figures for the previous year were 1 cwt. 74 lb. and 1 cwt. 33 lb.

The following table gives the results for the last three winters :

Table 1. Average Gains per Head

	1947–48	1948–49	1949–50
	lb.	*lb.*	*lb.*
Bullocks (10 in each lot)			
Lot 1 outwintered	56.40	113	52.1
Lot 2 inwintered	141.60	201	140.9
Heifers (7 in each lot)			
Lot 3 linseed cake ration	128	176.50	143
Lot 4 silage ration	105.43	137.75	97.3
Lot 5 bean ration	129.14	176.50	130.4

Note. For complete rations see Tables 2 and 3. These rations are the same as for the previous years, with the exception of the silage which, in 1947–48, was an arable crop mixture.

Table 2

BULLOCKS

WINTERED OUTSIDE v. WINTERED INSIDE, 1949–50

LOT I 10 Bullocks (Outside)	Ear Mark	Weight December 15	Weight Gain or Loss at Jan. 12	Weight Gain or Loss at Feb. 9	Weight Gain or Loss at Mar. 9	Weight Gain or Loss at April 6	Weight Gain or Loss at May 5	Final Weight May 5	Average Weight Increase per Head
		cwt. qr. lb.	*lb.*	*lb.*	*lb.*	*lb.*	*lb.*	*cwt. qr. lb.*	*lb.*
RATION PER HEAD PER DAY	B 31	4 2 12	16	38	18	35	—21	5 1 14	
lb.	B 48	4 1 0	15	—15	28	34	10	4 3 16	
Hay 12	B 35	4 1 26	14	9	—7	25	—67	4 1 0	
Oats 1½	B 18	4 2 19	9	37	23	51	—111	4 3 0	
Linseed Cake 1½	B 46	3 2 16	—8	—54	74	—	16	3 3 16	**52.1**
	B 2	3 3 16	12	—	—	41	—13	4 1 0	
	B 28	4 1 8	7	13	—28	36	—19	4 1 17	
	B 8	4 3 8	36	—6	18	44	—31	5 1 13	
	B 43	3 2 0	28	28	24	88	—15	4 3 13	
	B 21	4 1 4	40	36	—17	35	—5	5 0 9	
LOT II 10 Bullocks (Inside)									
RATION PER HEAD PER DAY	B 17	4 2 18	10	65	19	46	5	5 3 23	
lb.	B 49	3 2 10	16	38	48	28	10	4 3 10	
Hay 12	G 3	3 1 27	20	37	28	56	—13	4 2 15	
Roots 10	B 40	3 2 0	5	14	37	—56	22	3 2 22	
Oats 1½	Blk.	5 0 12	16	28	63	61	31	6 1 15	
Linseed Cake 1½	B 5	4 3 4	28	48	28	56	40	6 2 8	**140.9**
	B 14	5 0 0	28	40	60	12	47	6 2 19	
	B 32	4 1 26	22	20	21	24	64	5 3 9	
	B 45	4 0 13	6	37	—15	36	35	5 0 0	
	B 16	4 3 0	28	—48	27	77	54	5 3 26	

Table 3

HEIFERS

WINTERED INSIDE, 1949–50

LOT III 7 Heifers	Ear Mark	Weight December 15	Weight Gain or Loss at Jan. 12	Weight Gain or Loss at Feb. 9	Weight Gain or Loss at Mar. 9	Weight Gain or Loss at April 6	Weight Gain or Loss at May 5	Final Weight May 5	Average Weight Increase per Head
RATION PER HEAD PER DAY		*cwt. qr. lb.*	*lb.*	*lb.*	*lb.*	*lb.*	*lb.*	*cwt. qr. lb.*	*lb.*
lb.	B 20	4 1 0	56	9	—29	—23	—13	4 1 0	
Hay 10	B 36	4 2 7	53	—4	—	71	50	6 0 9	
Roots 10	B 37	4 3 9	18	1	52	44	56	6 1 12	
Oats 1¼	B 7	5 1 10	29	—	17	50	34	6 2 0	
Linseed Cake 1½	Blk.	4 2 6	58	32	42	46	29	6 1 17	**143**
	B 22	4 0 27	29	38	18	69	21	5 3 6	
	B 34	4 2 8	66	—1	23	25	35	5 3 16	
LOT IV **7 Heifers**									
RATION PER HEAD PER DAY	B 24	4 0 13	15	—2	—7	49	19	4 3 3	
lb.	B 27	4 3 0	20	6	8	9	21	5 1 8	
Hay 8	B 11	4 3 1	11	22	—2	48	16	5 2 12	
Grass silage 20	B 44	5 0 0	14	—14	36	33	23	5 3 8	
Oats 2	B 10	4 2 0	—	—	—18	58	44	5 1 0	**97.3**
	B 4	4 2 0	—	28	28	53	65	6 0 6	
	Blk.	4 1 8	30	14	—3	35	22	5 0 22	
LOT V **7 Heifers**									
RATION PER HEAD PER DAY	B 19	3 2 23	45	28	38	39	42	5 1 19	
lb.	B 13	4 0 2	39	6	37	10	38	5 0 20	
Hay 10	B 12	4 0 9	42	33	18	15	—8	4 3 25	
Roots 10	B 23	3 2 0	28	—	36	28	—44	3 3 20	
Beans 1½	B 25	4 0 0	56	22	12	32	54	5 2 8	**130.4**
Oats 1½	B 38	3 1 12	31	17	24	54	23	4 2 21	
	B 41	3 2 22	34	—9	37	40	16	4 3 0	

WINTERING STORE CATTLE AT COCKLE PARK

The 1949 crop of linseed at Cockle Park yielded 15 cwt. per acre and the sample was of good quality.

The writer wishes to express his appreciation of the valuable assistance given by his colleagues, Mr. G. A. Blackett, B.Sc., in the compilation and checking of the tables ; and to Major J. H. Murray, Farm Manager, and Mr. W. Harbottle, Stockman, for their care in carrying out the trial.

POPLAR AS A FARM CROP

T. R. Peace, M.A.

Forestry Commission Forest Research Station, Alice Holt, Farnham, Surrey

POPLAR is a crop which could be worked into the economy of many farms without any alterations in layout or cropping and, without any great expenditure of money or time, would eventually form a useful addition to the income of the farm. In many parts of America, where farms were carved out of the forest, the rougher ground was never cleared and is still retained as forest. It forms a useful source of stakes, poles and sometimes of larger timber, and often provides an appreciable additional income. In this country farm woodlands are comparatively rare, and most farmers tend to regard the growing of trees as a science quite separate from, and indeed possibly alien to, agriculture. In the past, hedgerow trees have often been encouraged, either by actual planting, or by allowing promising suckers or seedlings to grow up when the hedge is cut. But now the tendency is to regard such trees as an interference with good husbandry, and to fell them as opportunity offers. This clearance of hedgerow trees is receiving a considerable impetus from the present demand for home-grown timber. It must be admitted that much of the hedgerow timber on farms is of poor quality, partly because it received little or no pruning and partly because some species used are often not suitable for growth as isolated trees. In some instances the trees can justly be accused of interference with crops growing near them.

It is probably not generally realized that the poplar is a tree which grows better alone than in competition with other trees ; it does better on agricultural than on forest soils (although it can be grown with success on the latter) casts a very light shade, and on most soils does not cause serious root interference with crops. In fact, poplar is a farmer's rather than a forester's tree.

There are situations in the forest, of course, where it can be planted with advantage, but it is on farms, and especially on lowland farms, that poplar should appear in quantity. On the Continent this has been realized, and in many parts of France, Holland, Belgium and Germany poplars are an integral part of the agricultural economy. But in Great Britain only a few pioneers have planted poplar on a commercial scale. Most of the existing poplars have been planted for ornament or shelter, and have not been tended in the way necessary to produce commercial timber.

In parts of the fens the unprotected soils blow badly during dry seasons. Not only does this result in some loss of fertility and serious loss of seed, but it also involves heavy expenditure on drain clearance, for much of the blown soil is deposited in the drains. It has been found that a judicious use of poplars along the field boundaries will greatly lessen this wind erosion.

This is a protective measure which will pay for itself, and need not therefore be charged against the fields which it benefits. On sandy, loamy or clay loam soils poplars can be planted in the hedges, but on heavy clays the root systems are too extensive and their interference with the crops makes hedgerow planting inadvisable.

Most Soils are Suitable Poplars will grow on any soil, provided it is not waterlogged, extremely dry, or excessively acid ; the actual rate of growth is determined mainly by the amount of water available, but also, of course, by the fertility of the soil. The ideal soil for poplars is a loam, with the water-table more or less constant at 3–4 feet below the surface. But drier soils will produce perfectly good poplar at a slightly slower rate of growth, and wetter soils are suitable provided the water-table falls to at least 2 feet in the summer and is never higher than 18 inches for any length of time. Winter flooding, even if quite prolonged, does no harm provided the water drains off fairly quickly once the river itself has fallen. Stagnant water lying over the roots can cause considerable damage. On stream or river banks, where the flow of water is constantly bringing fresh oxygen to the roots, poplars will grow in very wet ground, but farther away from the stream, where the water is stagnant, the oxygen is soon exhausted and the trees make very poor growth. For this reason in open, drained ground the trees should be planted fairly near to the drains.

It will be seen, therefore, that any farm that has a stream, a river or low-lying flat ground within its boundaries is capable of providing sites for poplar. Even if constant running water is lacking, there will be many sites which are perfectly suitable for poplar on the lower-lying parts of the farm. Poplars can be planted singly, in lines, in avenues, in groups or in plantations. Thus they can be set in any odd corner of land unsuitable for agriculture ; they can also be planted in single or double rows along farm roads, ditches or streams. Where, however, it is proposed to plant poplars adjacent to a watercourse, and it would be advisable to check with the local drainage authority that the action proposed is in conformity with their by-laws.

It should be noted that tree roots may cause shrinkage of the soil and consequent settlement of the walls of buildings, an effect which is probably more pronounced with poplar than with most other species. For this reason it is inadvisable on clay soils to plant poplar closer than 120 feet to the nearest wall or building ; on light soils this minimum distance can be reduced to 60 feet. Since poplar roots will inevitably seek water, the same precautions as to distance should be observed when planting poplars near sewers.

There is not a very good market for small sizes of poplar timber, though it can be used for fence posts or rails if creosoted. For this reason it is advisable to plant the trees at a spacing sufficient to allow them to reach timber size without thinning. In lines the minimum spacing should be 18 feet, and in groups and plantations a spacing of 22–24 feet each way is desirable.

Raising New Trees It is not possible to deal adequately with the raising and cultivation of poplar in the course of a short article, and only a brief outline, designed to give some idea of the work involved, can be included here. Poplars can be planted either as rooted plants or as unrooted sets. The former are more expensive to raise but have certain advantages, especially on drier sites. It is hoped that as interest in poplar cultivation increases, both plants and sets will become readily available commercially. At present the supply is rather limited and not always of good

Poplars in a corner of waste ground, showing under-planting with conifers

Poplar avenue along a farm road

The open-air system of pig-keeping

Top : A simple, home-made farrowing hut (Photo : G. W. Butcher)
Middle : Folding in quarter-acre paddocks (Photo : G. W. Butcher)
Bottom : A movable fattening pen made of steel scaffolding, showing hut, 40-gallon water tank and drinking bowl (Photo : Payne)

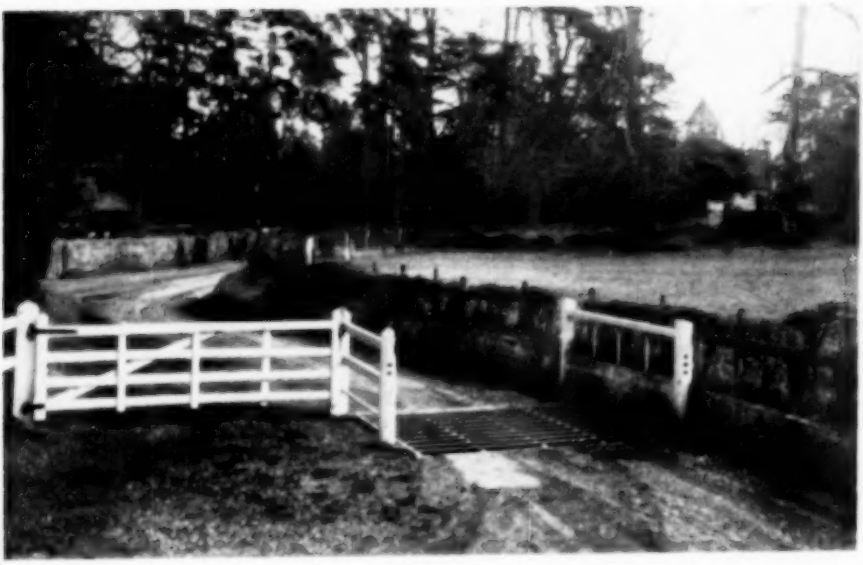
FULL USE OF STANDARD RETURNABLE LETTUCE AND CAULIFLOWER CRATES (See pp. 481-83)

Above : Standard returnable cauliflower crate, displaying curds in the top layer

Right : The same crate used as a soft fruit carrier

Photos : *A. Piper*

Standard returnable lettuce crate in use as a soft fruit carrier



A well-placed cattle grid constructed of concrete sleeper walls and rolled steel joists at Wasing Place, Aldermaston

Photo: *Edward Sweetland*

Close-up of the grid shown above

quality. It is possible for the intending planter to raise his own plants or sets and, by so doing, save transport costs and ensure good quality. Plants are grown from 9-inch cuttings of one-year wood produced from stool-beds, and sets from special stools of poplar cut back to the ground every two or three years. The best land available should be used for the nursery or set-bed. It is no good hoping to produce good planting stock from infertile or neglected ground. The details of nursery practice are set out in Forestry Commission Leaflet No. 27, *Poplar Planting*.* The object should be to produce straight plants 6–9 feet high and straight sets a foot or two taller.

Planting can be done any time during the winter, but good workmanship is essential. Even for a set, a reasonably large hole must be dug and broken soil replaced around the base of the stem. Where the situation permits, it helps to get the young tree quickly established if the ground around is kept free from competing vegetation for a few years. This can be done by mulching, hoeing, or making a shallow mound of soil over the roots. Here again, full information on methods is given in the above-mentioned leaflet. Fencing against stock and rabbits is necessary until the trees are well grown and firmly rooted. Stock can be kept off with a single strand of barbed wire until the trees are tall enough to be out of reach. Rabbits are best kept out by a sleeve of wire netting around the base of the stem.

Thereafter only pruning is required. This should, if possible, be done every year, removing one whorl and keeping about half the height of the tree free from branches. It is possible to carry out the operation every two or three years, but longer intervals than this mean that the branches become too large and are laborious to prune, apart from the risk of decay entering the tree through the wounds. As pruning gets higher, pole pruners should be used, the best form being a broad chisel with a cutting edge top and bottom fastened securely on a pole. Such a tool was described recently in the *Quarterly Journal of Forestry*†. This chisel is first pushed sharply up beneath the branch and then pulled down from above, which should sever the branch. With this tool trees can be pruned up to 18 or 20 feet. A good veneering log can be produced if pruning is stopped at that height, but if labour is available during hard weather in the winter, pruning can be carried higher, using ladders and billhooks, always remembering that not more than half the height should be pruned.

Recommended Varieties Poplar has a world-wide distribution in the northern hemisphere and hybridizes freely; consequently a very large number of species and varieties are available. Some of them grow poorly and are unsuitable for timber production ; some are subject to fungal or bacterial attack. Though many varieties would give quite good results, the following five are at present recommended for commercial planting in England.

Populus serotina, often known as the Black Italian Poplar ; *P. serotina*, narrow crowned variety ; *P. gelrica*, a Dutch hybrid ; *P. robusta* ; and *P. eugenei*, canker-resistant form. In all cases stocks should be obtained only from a really reliable source which can guarantee that they are true to name. This is particularly important with *P. eugenei*, since there is a similar tree, which is highly susceptible to bacterial canker. Many new hybrids are under trial, so that later it should be possible to recommend other varieties, some of which may supersede those already listed. But in view

*Obtainable from H.M. Stationery Office, or any bookseller, price 2d. (3d. by post).

†Brashing and Pruning Conifer Plantations, WOLRYCHE WHITMORE, G. C. **44**, 2.

of the risk of disease and the very wide differences in growth between various poplars, it is not safe to plant any untried variety until it has been thoroughly tested under a range of conditions.

Cost and Returns Intending planters would doubtless like to have some idea of the expenditure involved and the return to be expected. Unfortunately, with wages and prices inconstant, such a balance sheet will have only a very temporary value. Nevertheless, an attempt has been made below to give the figures for a single tree.

Debit	s.	d.	Credit	£	s.	d.
Cost of raising the plant	1	6	Planting grant		2	0
Planting	1	6	Timber 30 cu. ft. at 3s. per cu. ft. standing	4	10	0
Fencing (against stock and rabbits)	1	3				
Maintenance for first 5 years at 6d. per year	2	6				
Maintenance for next 10 years at 4d. per year	3	4				
Maintenance for last 10 years at 2d. per year	1	8				
	11	9		£4	12	0
Profit per tree (not allowing for interest on capital expenditure)				£4	0	3

It is assumed that maintenance for the first five years may involve some weeding, mulching, etc. For the next ten years only pruning will be needed, and during the last ten years of the assumed rotation of 25 years, only the occasional removal of secondary or water shoots from the stem is necessary. This rotation assumes that the poplars are on fairly good ground. Under very good growing conditions, poplars may reach timber size in just over 20 years. On poorer sites the rotation might have to be 30 years, or on ground marginal for poplar cultivation, even 35 years. The volume of the tree is an average figure based on observations in various parts of the country. It is a very low figure for really good growing conditions and wide-spaced trees. The price per cubic foot assumes a slight advance on the recently removed maximum control prices.

It could reasonably be assumed that on a 200-acre farm about 6,000 yards of line planting could be fitted in along hedges, roadsides, etc. Assuming a spacing of 18 feet, this will allow 1,000 trees. In addition, say, five acres of waste ground might be planted, which, at 75 trees per acre, would mean another 375 trees. With a rotation of 25 years, this would eventually allow the felling of 55 trees per annum. Actually, of course, the planter would want to put in his 1,375 trees over a fairly short period, say, five or six years, to get a quick start. Those that grow best might be saleable at 20 years from planting, and the poorest at 30 years, so that the production could be spread over a much longer period than planting, and something near 55 trees per year could be felled, bringing in an annual return of over £200.

It is quite certain that poplar would prove a valuable addition to the economy of many lowland farms. It is equally certain that the timber produced would find a ready market, owing to the many uses for which poplar timber is particularly suitable, e.g., matches, match-boxes, plywood, chip baskets, wagon bottoms, etc. It is a pity that up to the present such a useful tree has received so little attention in this country.

It should be noted that, subject to certain conditions, planting grants for poplars are available from the Forestry Commission. They are payable in two forms :

1. £8 per acre (minimum 2 acres) for planting in blocks, an advance of £4 being followed by payment of the balance after five years, provided the trees have been properly established and maintained.
2. 2s. per tree for planting in lines or avenues ; initial payment of 1s. followed by balance after five years. Minimum of 200 trees.

Full information and application forms can be obtained from the Conservators of Forests.

Acknowledgments are due to Lt.-Col. Pratt, Ryston Hall, and to M. L. Griffiths, Esq., Little Hallingbury, for permission to take the photographs shown in the art inset.

A COMPARISON OF BRITISH AND DANISH DAIRY FARMING

Sven Fisker

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THROUGHOUT the years, British agriculture has been an inspiration and a guide to Danish Farming in many ways. As a farmer with a particular interest in cattle breeding and the feeding of dairy cattle, it has been of very great interest to me to be able to compare how the two countries seek to solve one of the main problems common to both British and Danish agriculture, namely, how to increase livestock production on the basis of a large production of home-grown coarse fodder and a reduced import of concentrated food. This is a problem of great importance from many aspects.

During the autumn of 1949, I spent three weeks in England as a guest of the British Council and visited a number of farms in southern England, where I was shown great hospitality. My itinerary had been planned with particular emphasis on dairy farming, and I had the opportunity of visiting a number of well-run farms and of getting acquainted with some of the famous British dairy breeds, which was to me one of outstanding interest.

I soon realized that the natural conditions for agriculture—climate and to some extent soil conditions—differ greatly between the two countries. Britain has a milder and, in particular, a far wetter climate than Denmark and soil conditions vary greatly. These factors, of course, strongly influence the trend of production. Also we know in Denmark that British farming has greater difficulties than we have in obtaining adequate labour, and personal experience helps one to realize just how much influence this fact has on the farming systems in the two countries. For instance British farming is far more mechanized, and in Britain one talks about production per worker whilst we in Denmark talk in terms of production per unit of land.

Production in Fodder Units In Denmark we calculate on an average production of approximately 1,600 fodder units per acre from permanent pastures, 2,500 fodder units from our two-year-old red

clover pastures and 3,200 and 4,500 fodder units from our lucerne and root-crop fields respectively (1 fodder unit equals 1 Kg. barley). We are accustomed to compare the yield of various crops under different conditions on this basis and from that to decide their relative values. I know of no corresponding standard term for production in Britain. The present tendency in crop husbandry in Denmark would seem to be towards a greater utilization of fodder sugar beet with large tops and high dry matter content and an increase in the cultivation of lucerne at the expense of temporary grass and corn. This change will lead to a considerably higher production of fodder units as well as of protein.

Although I have been unable to make numerical comparisons, I have no doubt that the permanent pastures in Britain give a considerably higher yield than in Denmark. The greater rainfall in Britain contributes to a higher production of grass, and the winter climate, which is so much milder, makes possible a longer grazing season. In Denmark we count on a grazing period of 160 days and since during periods of drought in July and August production on pastures often stops entirely, it is easy to understand why we in Denmark cannot base the feeding of cattle on grass to the same extent as is done in Britain. For this and other reasons, we have to grow large quantities of roots. The Danish agriculture area cannot be expanded, as all usable land has long since been brought under cultivation. Greater production can be achieved only through a higher production per unit of land, a factor which adds emphasis to the importance of growing root crops. By using machinery for grass drying, the British farmer has an opportunity of utilizing an extremely valuable fodder. This type of fodder would probably be of great value to us in Denmark if used with large quantities of root crops, but unfortunately the machinery is too expensive and working costs are too high for Danish conditions in general. We do, however, use dried lucerne as a source of protein and carotine for poultry and pigs.

As for the conservation of green crops, our main interest is concentrated on ensiling root tops and lucerne. It was disappointing to learn that in Britain the interest seems mainly concentrated on ensiling in pits, where tractors and wagons are used to compress the material. The method has been used in Denmark for many years but we do all we can to discourage it because of the great loss involved by using this method, both in respect of direct surface loss and the loss of dry matter—and particularly protein content.

At present we are using the Finnish A.I.V. method ; on small farms we use sunken wooden or concrete silos, and on the large farms with more than 25 cows, reinforced concrete silos 20-40 feet high and 12-17 feet wide.

Comparisons in Herd Management The differences in climate in Britain and Denmark are also expressed in the design of cowsheds and the management of cattle. When we enter an English farmer's cowshed or yard we are confronted with building principles quite unfamiliar to us. The consideration paid to fresh air and good lighting in cowsheds is obvious and appeals to us. It was a pleasure to walk round some of the newly-built cowsheds with plenty of roof lighting. I recall particularly the yard and milking parlours at Wye College Farm. Altogether, it was gratifying to see the high standard of milk hygiene on the farms which I had the occasion to visit. When Danes discuss the planning of cowsheds, the main problems, apart from the question of arranging for reasonably sized boxes, are ventilation and insulation. In our climate these two factors are of prime importance in our efforts to achieve economic production.

When I saw for the first time British cows out grazing or in open yards at Christmas time, I thought of my own cows at home which had been in their warm cowsheds for two months, and the question inevitably arose as to what influence the various methods of management have on the health of the cows and their yield. Actually, a comparison is misleading because the climate is so different. In Britain, with a relatively mild winter, it is quite natural for cows to be turned out to get some exercise and to save labour. Similarly it is natural for us to keep indoors the cows which give from 4 to 8 gallons a day, when the temperature outside for four months may vary from 4° to minus 20° Centigrade and the weather changes from rain to snow with a constant wind. In this connection I remember a remark made by a veterinary professor that our modern dairy cows were not created for winter sports ! The remark was directed particularly at streptococcus—and, for that matter, at all infections of the udder, which appears to be very susceptible to cold and draught. In many of our large herds we have succeeded in practically eliminating streptococcus by carrying out such precautionary measures as the division of boxes, the removal of barbed wire from partition fences, by measures to prevent draught in cowsheds by appropriate ventilation, and finally by insulating the boxes. Before we introduced these precautionary measures, laboratory analyses proved that in the same herds streptococcus was detected in one or more quarters in 43 per cent of the many thousands of cows included in the investigation.

Does the daily exercise in the open air provide a better protection against bovine tuberculosis ? I am inclined to think not. In spite of our long period of 200 days spent in the cowshed, tuberculosis has been eradicated in Denmark after 20 years of work on this particular problem, based mainly on the separation of reactors in accordance with the compulsory yearly tuberculin tests carried out among all herds in Denmark. Of recent years, the same method has been used against infectious contagious abortion, and the results achieved appear far more favourable than we had dared to hope when the control first started. We now look forward to a complete eradication within a relatively short time.

During the later winter months we often find it difficult to get the cows pregnant. This is probably due more to deficiencies in fodder than to the actual length of time in the cowshed. At any rate, it seems as if hay and silage of really good quality have a favourable effect on this problem.

As regards the conformation of cattle as a feature of breeding, it was very interesting to come across the opinion—which I have not previously heard expressed—that a strong loin and long, level hindquarters are indications of a well-formed udder. The remark interested me, particularly as a weak loin and often a rather short and pendulous udder are common defects in Red Danish dairy cattle which, according to our estimation, are fairly good animals. I took it as a compliment when an Ayrshire breeder—after a visit to Denmark—wrote to me and said that he was very pleased to see our red cows. " They were nearly as good as our Ayrshires," he said (and moreover he was a Scotsman !)

I was pleased to hear that there are some British livestock judges who exclude cows from further judging if there are many faults in regard to the shape of the udder—a radical step to take, but certainly a correct and commendable one.

Emphasis on Butterfat Content It is difficult for Danes to get used to the British method of estimating figures of yield. In Denmark we always work with the full production year from October 1 to September 30, and we take into account the quality of the milk,

the fat percentage and the total production of butterfat. It is difficult therefore for us to find a term for the yielding capacity of cows over very different periods and quoted in different terms such as pounds or gallons, with or without fat percentage. Quite apart from the fact that milk in Britain is not paid for according to its fat content, as is the case with all milk in Denmark, I should think that the individual breeder would have a considerable interest in obtaining information of the capacity of his breeding animals for the production of butter fat, as the economy of both feeding and milk production is closely connected with this factor.

One measure which Britain has introduced and which many of us envy, is the system of rationing concentrated fodder, based partly on the quantity of milk produced. It is difficult to explain why, in Denmark, we allocate such fodder per cow without regard to its yield. Our feeding is individual and, to a great extent, based on comprehensive research and advisory work, and there is considerable agitation for a still more rational calculation of the feeding plan. Herds with animals giving 500 gallons of 4 per cent milk receive the same quantity of concentrated fodder per cow as herds giving 1,500 gallons of milk per cow.

I gained further from my visit to English farms and herds by meeting several British advisers dealing with the various branches of agriculture. It was interesting and instructive to become acquainted with the structure of the British agricultural advisory system and to learn a little about the problems which have to be solved in order to put into practice, to the greatest possible extent, the results from scientific and practical research. The constitution of the agricultural organizations is different in the two countries, and I think it would be of great value if the efforts made by each country in recent years to extend their knowledge of the organizations in various European countries could be continued and extended.

POULTRY STOCK IMPROVEMENT PLAN

County Lists of accredited breeders and hatcheries for the 1951 season are now available, free of charge, from County and Provincial Offices of the National Agricultural Advisory Service. The lists show the breeds of poultry in respect of which the stations are accredited and the approximate number of accredited stock on each station.

A Register of Accredited Poultry Breeding Stations and Accredited Hatcheries in England and Wales is in preparation.

FULL USE OF STANDARD RETURNABLE LETTUCE AND CAULIFLOWER CRATES

A. Piper

Land Settlement Association, Newent, Glos

So much is heard nowadays about the grading and packing of fruit and vegetable produce, and there are such a variety of manufacturers making a multiplicity of packages that one wonders why it is that we do not design and produce a standard range of containers which could be used for all our crops. Until a cheaper type of non-returnable article is available, we shall continue to rely on some kind of returnable empty and these, being expensive, will have to be made full use of throughout the year.

For some years I have found two returnables very useful for a number of crops outside their normal range ; they are the standard-sized lettuce crate and the standard-sized cauliflower crate. The latter can be used to good advantage for a variety of vegetable crops and as a chip carrier for fruit. They will do many journeys. The lettuce crate can be used for many early crops when the price justifies the extra expense. Presentation in these crates is far superior to the rough manner in which many of these commodities are usually packed, and there is no crushing in transit.

Produce from the packing station or the field can be made or marred by its container, and it is well to remember that it is not the condition in which produce is picked but its condition on arrival at the market next day which really matters. I have usually found that salesmen or buyers do not mind paying the deposit on returnable crates so long as the produce in them is of good quality. It is most noticeable that produce travels better and arrives better in these packages ; indeed, early peas, broad beans and runner beans arrive with the bloom still on them.

Uses for the Lettuce Crate *Early carrots* are pulled, graded for size, washed, bunched and packed in a paper lined lettuce crate with the roots facing each end of the crate. The tops are cut so that they do not cover the carrots in the opposite layer, and when the packing of the crate is complete the carrots show at both ends and the green tops show only in the centre of the crate. Thus the buyer can see what he is buying. Three grades are packed in this way—the Selected Grade, twelve bunches to the crate ; First Grade, eighteen bunches ; and a smaller grade, twenty-four bunches to the crate. Two pieces of paper are used for each crate ; these are folded over and tucked in, the whole being secured with a piece of string at each end.

Later in the season, when the demand for bunched carrots slackens and a larger root is required, the lettuce crate can be used again for *Selected Washed Carrots* without tops. The crate will take 36 lb. of washed roots. It will be found that if packed in this way, the produce arrives at the market in a better condition with much less bruising, and it will keep longer than similar produce marketed in bags. Further, it shows to better advantage when displayed in the shops. The second grade can be marketed in bags in the ordinary way. This manner of marketing can be practised profitably until the bulk crop comes in, i.e., at about the end of July.

Very early peas are marketed by the Newent Estate of the Land Settlement Association in 12-lb. wooden tomato chips. These will take 8 lb. of peas but, as the price falls, the lettuce crate is used for 20-lb. packs. In this container there is no crushing of the pods, as is experienced when using bags,

nor is there any heating as sometimes happens in bags. The peas arrive on the market in perfect condition with the bloom still on the pods. If the crate is lined with white paper, the peas also show to best advantage. Similar remarks apply to *early broad beans*, *French beans* and *stick beans*, the lettuce crate being used for the best grades. The pods should be young and of good average size, and the crate should take 20 lb. It has been found that the best crops well repay the trouble of presenting in this fashion, but it should be borne in mind that the method will not improve the appearance of second grade produce ; only the best should be sent to market thus.

With *early marrows*, too, the lettuce crate can give good service. The marrows should be cut so that they can be packed in two layers across the crate ; they should be young and wiped clean before packing. The crate should take ten marrows. As prices fall, the standard cauliflower crate can be substituted and the pack increased to 18 or 24. With this method, there is no bruising in transit as often happens when the marrows are marketed in bags.

A further use for the lettuce crate is as a punnet carrier for *selected soft fruit* such as raspberries and strawberries. The crate will take a single layer of eight punnets or, if a central partition is fitted, as many as sixteen punnets can be packed without damage to the fruit on top.

Our lettuce crates are actually in use nearly all the year through, and we can profitably use them for marketing eleven different crops. The salesman likes the package and so, too, does the retailer as, compared with the many inferior types of package in use, it helps considerably in selling the produce.

The Cauliflower Crate The standard returnable cauliflower crate with lid can be put to many uses as both a vegetable or a soft-fruit carrier, and the crates are thus in use throughout the year.

In the early spring the cauliflower crate is used for best grade *cabbage*, trimmed and laid butts outward, either 18 or 24 to the crate in two layers. They are in use at about the same time for *bunched carrots* and *broccoli*, and later there follow *early cauliflower* and *bunched beetroot*. All these crops can be made up into excellent packs by means of the cauliflower crate. A little extra trouble needs, of course, to be taken in preparing, grading and packing the produce in this way, but its superior condition on arrival at the market and the attractive appearance of the produce so packed amply justifies it. Further, there is no bruising of the produce in transit and it will keep longer after it has reached the hands of the retailer.

The cauliflower crate is used also for *marrows* when the price for the early crop has fallen and it no longer pays to pack them ten to a lettuce crate. Eighteen or twenty-four marrows may be packed, according to size, in this way. They should be laid lengthways in the crate which, as a rule, will take three layers. The same crate is used for outdoor *rhubarb*, which again is packed lengthways with 36 to 48 bundles, according to grade. Self-blanching *celery* may also be marketed in the cauliflower crate. It should be washed, graded and tied in bundles of 6 for the best grade, and 12 for the second grade, and then placed lengthways in the crate, which will take nine bundles of 6 for the best grade and twelve bundles of 6 for the second grade. When marketed in this fashion the celery arrives on the market in good condition ; the sticks are fresh and free from bruising.

Like many other market gardeners, we grow a good proportion of *soft fruit* and the strawberry, raspberry, redcurrent and blackberry crops are marketed in small packages such as punnets, 2-lb. chips and 4-lb. chips. The manner of utilizing the lettuce crate as a returnable container for punnets has already been described but, as most growers know, chips loaded loose,

either on lorry or rail, do not carry well and frequently on arrival at the market the lowest chips are a sorry sight with the fruit crushed and juice running out at the bottom. All would agree that some kind of carrier should be used so that the chips are protected, the bottom ones carrying no undue weight and the whole consignment arriving at its destination in good condition.

Returnable bushel boxes are used in some cases for this purpose but it is not easy to make a good pack in them. In addition, there is no lid to protect the fruit if the boxes move in transit (as is often the case when put on rail), and the top chips suffer damage. Again, the bushel box is a heavy container and, transport charges being what they are today, one has to look for as light a container as possible—more particularly where the fruit has to travel by passenger train.

Here again, the cauliflower crate comes in for further service and has been found both useful and successful. I have used it over a number of years as a chip carrier, and have found that the fruit packs well, the crates stack well and no damage is suffered by the fruit in transit if it has been picked in good condition. The standard cauliflower crate with lid will take twenty-four 1-lb. chips, sixteen 2-lb. chips or nine 4-lb. chips. The crates can be stacked as high as required without danger of crushing, and there is plenty of space through the sides of the crates for air to circulate while the fruit is in transit.

There are many different notions about the packing of *cauliflower* and *broccoli*. Some are marketed untrimmed, some partially trimmed and others fully trimmed. But why send all the extra leaf to market when the retailer trims it back to the curd before he sells it ? It is not necessary to pack in single layers because the leaves are trimmed close to the curd. There appears to be a keen demand for closely trimmed cauliflowers, and the trimmed article makes a very attractive pack in the standard returnable cauliflower crate. Best selected grades will repay the extra cost and labour of covering each head with a sheet of transparent film, and they will then keep longer in a good condition. However, covered or not, the packs are the same and are usually in 15s, 18s, and 24s. The bottom layer should be packed on its side, butts outwards and the top layer placed with curds uppermost. In between there is a centre row packed with the curds downwards to save bruising. By this means the buyer can see what he is buying, and that in the end is what counts.

SOILLESS CULTURE: RECENT DEVELOPMENTS

C. E. TICQUET

Hon. Secretary, Soilless Culture Society

SINCE the circumstances of war so greatly stimulated the development of soilless culture by the United States Army Air Force, a good deal of fresh knowledge has been obtained about the requirements of growth by this method. Much of the work of the American Army Air Force was carried out in tropical conditions, and hence in the presence of factors not likely to be encountered in Great Britain. Much of it, too, was undertaken more or less regardless of cost, since it represented the only method of supplying scattered bodies of troops with fresh vegetables when local conditions made it difficult or impossible to meet their needs from the soil. Much of it, again, was carried out on a scale too large to suit the ideas of growers on this side of the Atlantic. Nevertheless, valuable lessons were learnt which have application everywhere that soilless culture is practised.

The experience gained was first published in detail in 1946(1) but since then the vast 80-acre soilless culture farms in Japan have been brought into full operation, and units elsewhere have continued to yield information that so far exists in a collected form only in the files of the United States Army in Washington. Through the courtesy of the office of the Quartermaster-General of the U.S. Army, I have been given the opportunity of inspecting this material, and so enabled to gather the basic material for this article.

Perhaps the most important of the conclusions of the military culturists is that after more than six years of intensive installation and cultivation they definitely affirm that soilless culture should be undertaken only when normal methods of growth are impractical, arising from :

1. Lack of suitable soil;
2. Inadequate rainfall;
3. Human disease organisms in the soil;
4. Transportation difficulties or cost;
5. Inadequate cold storage facilities.

Warnings given long ago by such pioneer research workers on the subject as Professor R. H. Stoughton(2) are confirmed. "Hydroponics is not a cure-all for agricultural ills," it is stated. "Its field of application is highly specialized and it is limited economically to crops bringing a high return per acre." One of the major limitations, it is added, is that in addition to plant sense and growing experience, the operator must have a thorough understanding of plant physiology and more than a passing acquaintance with certain aspects of chemistry before he can be confident of success.

Sub-Irrigation Methods Preferred

It would serve no useful purpose here to go into the details of the methods used by the Americans on Ascension Island, in British Guiana, and at the installations elsewhere. Suffice it to say that the general verdict is underlined that both water culture (in which plants are suspended over tanks of liquid) and sand culture (in which they are bedded in sand and watered from above) are inferior to sub-irrigation, (in which they are periodically watered from below). The experience of American experts apparently agrees entirely with that of Dr. W. G. Templeman(3) in trying out water culture at Jealott's Hill.

Some of the most useful advice disclosed by the American experience is neither horticultural nor chemical, but mechanical. One of the costliest mistakes, for example, arose from the idea of using raised storage tanks for the chemical solution and feeding the beds by gravity. This economized in valves and piping, and also in the size of pump required, since instead of having to pump from an underground tank as quickly as possible, the solution could be drained into a sump and pumped again at leisure. Unfortunately, however, if the pump were electrically operated, as was usually the case, and the power failed, the solution had to remain in the beds so long that the plants were drowned. The moral is : if you rely on gravity, be sure to install a sump large enough to contain all the solution from the beds, and into which it can drain in an emergency.

Concrete Structure Recommended

Materials used on construction, too, have been simplified. At the beginning of the war, wood, asphalte mastic, prepared bituminous surfacing, and a number of other materials were tried and sometimes recommended. It is now possible, however, to state definitely that concrete is the most economical type of construction. It is strongly recommended that only concrete be used. For tanks, steel is named as the first preference.

Severely practical, too, is the final verdict on the policy formerly advocated of clearing away all natural vegetation in the vicinity of soilless culture beds to prevent risk of infection. It was found that soilless-grown plants, with roots holding less securely than in soil, were liable to suffer more wind damage. Clearing away natural windbreaks seriously increased the risk of this damage. Not only is the native vegetation now left alone, but the sowing of natural grass on the paths between the beds is actually recommended to provide more congenial conditions for the plants in the beds themselves. What a significant change from the "chemical growth only" policy !

Damage of another kind is caused when tools are stored in the same room as the salts used for making up solutions. Even if some distance apart, this results in rapid corrosion of the tools and frequent need for replacement. Ordinary gardeners may have had the same experience with tools placed near bags of sodium nitrate or superphosphate.

But it is in the technique of soilless culture itself that the American experience is most valuable, as of course should be the case. A typical example is the order of adding chemicals in mixing solutions. As recently as 1948(*) it was laid down by the Withrows that : "the order of addition is not very important, but it is easier to dissolve the more insoluble salts, monocalcium phosphate and calcium sulphate, before the others". *Nutriculture* of 1950 declares, on the other hand, that : "If the various chemicals used to prepare the nutrient solution are not added to the water in the correct order, excessive precipitation of essential elements will occur . . . the directions listed must be followed exactly as written." The directions given then repeat that they must be followed exactly, and then give this order of addition :

1. First, magnesium sulphate
2. Second, monocalcium phosphate
3. Third, such chemicals as potassium nitrate, potassium chloride, potassium sulphate, or sodium nitrate. In case several of these chemicals are used, they are added in that order – e.g., potassium nitrate before potassium chloride
4. Calcium sulphate

Again, for micro-nutrients, it is specified that they must be added exactly in the following order :

1. Boric acid
2. Zinc sulphate
3. Ferrous sulphate
4. Manganese sulphate
5. Copper sulphate

This is the first occasion on which any authoritative work on the subject has so definitely attributed importance to the addition of minor elements in a particular order, and undoubtedly this is a matter which is still open to question.

Methods for chemical testing of nutrient solutions by colorimetric analysis have always necessarily been exact, but if possible the details on this aspect have been laid down even more specifically than before. Here again, those British operators who have followed the lines laid down by Stoughton and Fawcett[5] with success will doubt if such imperative directions are really desirable.

When to Feed The number of times various crops should be irrigated has been a point of contention since soilless culture came out of the laboratory into the greenhouse in 1929. Remarkable differences in recommendations have tended to confuse the grower unversed in the subject. The truth is, of course, that no general recommendation is possible. The time and the number of times to feed depends on the crop, the stage of maturity, the season, the weather, the type of aggregate, and several other conditions. In England, however, for tomatoes it has usually been agreed that twice a day in the summer is adequate. The American experience (and we have to remember that much of it was tropical) is that for tomatoes in summer three times a day is necessary, and for cucumbers as much as five. Under these conditions, pumping must be pretty nearly continuous, and certainly expensive if the pump is at all powerful.

Latest practice in the discarding and changing of solutions, however, points to the use of less labour rather than more. In this matter experience seems to have turned back again to the recommendations of 1939[6]. After the first year or two of military operation, it was decided that it was best to change solutions every two months. Now it is admitted that the same solution, tested and adjusted periodically, can be used for periods of three to six months without detriment, especially if water supply is a problem. When reservoirs of many thousands of gallons are concerned, this is an important concession.

Invaluable tables of requirements of chemicals, giving the quantities needed for specific areas have been built up over the years. Particularly useful for those about to undertake operations on a scale to which they are not accustomed are the tables of requirements for unit areas of 10,000 square feet.

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WILLIAM CURTIS AND THE BRITISH GRASSES

NIGEL HARVEY, M.A.

WILLIAM CURTIS was born in 1746, and he died in 1799. His life, therefore, was passed in one of the greatest periods of agricultural development in our history. Yet Curtis was not a farmer ; neither was he directly concerned with farming. He was by trade first an apothecary, then a botanist, and, though born at Alton in Hampshire, he spent most of his life in London, while his enduring monuments, the *Flora Londinensis* which he compiled, and the *Botanical Magazine* which he founded, were on paper, not on the land. Indeed he valued the fields more for their weeds than for their crops and was, for instance, particularly delighted with Battersea Fields, at that time still open country, where " the bad husbandry they exhibited to perfection " produced a wealth of fascinating but deplorably non-agricultural plants. Nevertheless, though his spiritual home was the garden rather than the farm, his work has earned him a lasting place in agricultural history, for he was a pioneer in one of the most important of all branches of British farming—the growing of good grass.

Six Species for Good Grassland Of course, grass is one of the oldest "tools" of the farmer ; man has been a grazier ever since he first domesticated cattle and sheep. But it is only in comparatively recent times that he has learned to grow grass as a crop, for our ancestors were dependent for their grazing and their hay on whatever pasture their particular district happened to produce. They could certainly *improve* grassland by cultivation and manuring, but they could not *create* it ; they could only allow nature to create it for them when they let arable land tumble down to whatever sward the birds and the winds chose to seed there. And in this country the modern grassland story only begins in the seventeenth century, with the coming of red clover to the farmer's fields. But though the grasses proper were, it appears, sometimes sown by enterprising men in this period—there is a reference to the sowing of perennial ryegrass in Oxfordshire in 1677—it was not until the middle of the eighteenth century that they were put on the agricultural map by Benjamin Stillingfleet, who published his *Calendar of Flora* in 1762. Yet it is significant that we owe to this single, casual enthusiast the very names of many of our grasses which the uninterested farmers of his own day had not apparently even bothered to identify, while in the general progress of the Agricultural Revolution grassland development lagged far behind arable. At the end of the century, for instance, Curtis could write sadly : " If we examine our meadows, pastures and downs, we shall find them pretty much in a state of nature and, excepting those pastures which of late years have been sown with ryegrass or clover, full of an indiscriminate mixture of plants, some of which afford good food, others bad food, some good crops, others hardly any crops at all." It was primarily to improve this condition of things that in 1790 Curtis published his little book entitled *Practical Observations on the British Grasses, best adapted to the Laying Down and Improving of Meadows and Pastures, to which is added an enumeration of the British Grasses.*

He begins the book in brisk, practical fashion, first quoting the opinion of " the more enlightened agriculturists of our present day" that much of our grassland could be greatly improved by the introduction of some of our better grasses and then asking why these good grasses are so little known

and so seldom used. The reason, he thought, was partly the natural conservatism of farmers, partly the unsound information and arguments used by some previous writers on the subject, and partly the extreme practical difficulty of obtaining seeds, as he himself knew, having received many requests for seed from farmers and others. For the arguments of Stillingfleet and the premiums of the Society for the Encouragement of Manufacturers, Arts and Commerce had alike failed to interest the farmer in collecting or cultivating grass seeds, and in the later eighteenth century almost the only type of seed commercially available was ryegrass—perennial ryegrass, not Italian. The latter did not enter this country until 1833—and even this, it seems, owed its availability less to its agricultural value, which many men of the time doubted, than to the ease with which it could be collected. Neither was it wholly a sign of progress that another type of grass was just appearing on the market. This was known at the time as soft meadow grass, but today we call it Yorkshire fog.

Curtis was, therefore, really writing a tract rather than a treatise, for he was preaching as well as informing. He wanted to recommend good grasses, he wanted them to be easily understood, and he wanted their characteristics to be widely known. Hence his choice of six good species which he describes in considerable detail and illustrates with delightful and meticulous draughtsmanship. These six species, he held, represent all that is generally necessary to grassland salvation :

> The grasses recommended will do all that natural grasses can do. They are six of those which constitute the bulk of our best pastures, most of them are early, all are productive. . . . But let no one expect them to perform wonders, for they are liable to produce great or small crops according to particular seasons and the fertility or barrenness of the land where they are sown.

His choice is interesting. First comes *sweet-scented vernal grass*, which he noted grows impartially in bogs, woods, rich meadows and dry pastures, then the productive *meadow foxtail* and next *smooth-stalked* and *rough-stalked meadow grass*, the former preferring dry, the latter moist conditions. The list concludes with *meadow fescue*, which Curtis greatly preferred to ryegrass, and *crested dogstail* for drier land. Where, then, are our familiar ryegrass and cocksfoot ? They are among the unregarded, along with bent, Yorkshire fog, brome, tall oat grass, etc. Cocksfoot is described, reasonably enough, as "a rough, coarse grass, hardy and productive," but the verdict on perennial ryegrass is patronizing rather than enthusiastic :

> "Though not possessing all that is desirable in a grass, it is not to be considered as of no value and indiscriminately rejected," for it grows rapidly and is acceptable to cattle. Further, "much yet remains to be known of this most common grass and as we have improved varieties of plants for agricultural purposes, we think it highly probable that much might be obtained from this grass."

The Making of Pasture But knowledge is of little use without the tools to exploit it, and the directions which Curtis gives for sowing down permanent pasture are particularly interesting, for they illustrate in striking fashion both the technical and the commercial conditions of his time. He assumes, for instance, that the seeds of the grasses he mentions are not stocked by merchants, and therefore announced, at least in his second edition, that a packet of seeds which he recommended could be obtained at a cost of 10s. 6d. from the publisher of his book.

Clearly, therefore, the progressive farmer of those days was expected to raise his own supply of seed. Commerce had as yet hardly begun to serve the grass-grower.

Curtis gives little information on tillage, though he insisted on proper cleaning of the land. If you are resowing permanent pasture, he says, plough it up and harrow it repeatedly to rid the soil of couch ; if it is foul, pare off the sward and burn it ; and in extreme cases use a cleaning crop, such as turnips or potatoes, before sowing. The mixture he recommends is :

> Meadow foxtail 1 pint ; Meadow fescue 1 pint ; Smooth-stalked meadow grass ½ pint; Rough-stalked meadow grass ½ pint; Crested dogstail ½ pint ; Sweet-scented vernal grass ½ pint ; White clover ½ pint ; and Red clover ½ pint.

This "composition" was to be sown at the rate of 3 bushels to the acre. Taking, say, 20 lb. of seeds to the bushel as an average for these seeds, this makes 60 lb. of seed per acre. Presumably, therefore, Curtis was allowing a wide margin for errors.

Such a mixture, he assures the reader, will produce " a most excellent meadow " in two years and if it gets foul it should be ploughed up again and reseeded either with the same " composition " or, he adds prophetically, " with a better one when such shall be discovered ; for I have no doubt but, at some future time, it will be as common to sow a meadow with a composition somewhat like this as it is now to sow a field of wheat or barley". If, however, the meadow needed improvement rather than renovation, he recommended light dunging with well-rotted manure in September, bush-harrowing, and then sowing with " the same composition of seeds but in a smaller quantity".

He concludes with a lengthy enumeration of the British grasses and some general remarks on the "points" of permanent pasture. Firstly, it should be productive, yet quality should not be sacrificed to bulk, and there is no need to specialize in such coarse grasses as cocksfoot and meadow sweet. Secondly, it should be nutritious and palatable to stock or, as he says, *bateable*, " an altogether agricultural, perhaps provincial word, used to express cattle thriving on the food they eat". But, he adds, though we know cattle eat what we grow for them, we do not know what species they prefer. "This particular tendency remains to be ascertained by experiment," and he hopes that " noblemen and gentlemen " will send him turfs cut from good pasture so that he can examine the species they contain. Thirdly, the pasture should provide good, early growth, for the hardy swede and the fly-resistant mangold had not yet come to the fields of the normal farm to reinforce the turnip which in times of fly, drought or frost was proving a painfully unreliable crop. To the contemporaries of Curtis, therefore, early grass was a valuable and necessary insurance against a poor root harvest and the consequent " hungry gap " in the spring. Here, however, the farmer could to some extent help himself by sowing such early species as sweet-scented vernal, meadow foxtail or either of the meadow grasses, while growth could be encouraged by a wise choice of site. " Pastures should be warmly situated, not drenched in moisture, sheltered by thick hedges and divided into small enclosures." Curtis ends his book with a reflection, at once penetrating and revolutionary, " We have sometimes thought, but perhaps the idea is too speculative, that we ought to have two sets of meadows, one for hay and one for pasture".

The Foreshadowing of Grassland Husbandry Thus does Curtis the agricultural botanist summarize the most advanced knowledge of his day, and the interest that his book aroused is shown by the number of editions which were issued ; first published, it would seem, in 1790, it was reprinted in the same year and again in 1798, 1804, 1805, 1812, 1824 and 1834. But his arguments also illustrate the difficulties which beset the grass-grower in the days of the Agricultural Revolution. For one thing, there was this crippling inability to obtain seed and this must surely have encouraged, except among the most enterprising of farmers, that traditional reliance on " the sweepings of the hay barn " which did no more than continue the old sward of the district. And it was long before this weakness was remedied. In 1817, for instance, Coke of Holkham was still hiring women and children to collect cocksfoot seed, though it was then appearing on the market, while the credit for creating regular sources of supply for the various grass seeds goes, apparently, to Lawson of Edinburgh who flourished in Early Victorian times, half a century after the death of Curtis. Further, the peculiar manurial requirements of grassland were as yet entirely unknown and in any case, though ground bones were used in some areas, fertilizers as we know them today were still far in the future. Against this background, therefore, we can easily understand the origins of the second half of the old saying, " To break a pasture makes a man ; *to make a pasture breaks a man*". On this W. S. Mansfield has commented : " Up to fifty years ago the making of a permanent pasture was a dark and difficult adventure and not one to be undertaken lightly. At best it was a slow and expensive business and even in the most favoured districts the results were uncertain." It is significant, for instance, that about 1815 a Norfolk farmer, dismayed by the cost and failures of local attempts to establish good grassland, earned both praise and publicity by developing a method of " inoculating " ploughland with turfs cut from a good sward. In fact, he gave up trying to sow grass and contented himself with transplanting grass which Nature herself had sown.

Indeed, it was long before the work of Curtis was to bear fruit, for the farming audience he addressed lacked economic incentive as well as technical resources. King Corn reigned in the fields at the time of the Agricultural Revolution and grass played a secondary part in the farming system of the time. But the importance of his book is twofold ; it records the advanced practice and reasonable hopes of his period, and it illustrates the historical development of this important branch of agriculture. Curtis was a pioneer who strove to extend the frontiers of farming science and practice by converting grass from a self-willed ally to an obedient servant, and the means he used was the exact and detailed knowledge which comes from prolonged study and observation. He was one of the first Englishmen to grasp the agricultural importance of the differences between the various species of grass, to analyse their properties and to present his findings in clear and simple form. Thus he tried to provide the farmer with some of the tools with which he could do a better job, the " intellectual tools " of fact and principle and the " physical tools " of the seeds of the various grasses which could not readily be obtained elsewhere. The agricultural botanist, the seeds merchant and the grassland advisory officer may, therefore, regard Curtis as not the least interesting or important of their professional ancestors.

FARMING AFFAIRS

Phosphate Fixation Owing to low soil temperature, corn sown about the end of October or beginning of November had not in some cases brairded by the beginning of December. Anxious farmers having heard that phosphatic fertilizers tend quickly to change in the soil into types that are unavailable to plants, are wondering whether water- or citric-soluble phosphate applied at seed-time will have become inert before the young plant is able to make use of it. It has also been impressed upon them that phosphate is of pre-eminent importance to crops, especially cereals, during their first few weeks of active growth. Most experts seem to agree that, in a soil which is neutral or only slightly acid, water-soluble phosphate usually reacts with soil calcium to form a type of calcium phosphate only slightly soluble in water but, nevertheless, readily available to plants. It will not wash out in the drainage and will remain available for a considerable time, perhaps long enough to benefit several crops in succession.

In calcareous soils, water-soluble phosphate is soon converted into relatively unavailable forms and should, in the interests of economy, be applied only in quantity sufficient to supply the needs of one crop for one year.

In very acid soils, water-soluble phosphate quickly becomes fixed and almost completely unavailable. Lime or chalk should, in such cases, be added to neutralize acidity before soluble phosphate is applied.

For most crops, water-soluble phosphate is generally the best form to apply, but basic slag, particularly slag of high citric solubility, will often produce herbage of greater nutritive value on grassland. Moreover, in moist soil, such slag seems quickly to behave very like the phosphate in superphosphate. On the other hand, slag of low citric solubility is not, as a rule, effective on neutral and alkaline soils, especially under low rainfall. The same is true of mineral phosphate. But both are often satisfactory on acid soils, especially for grassland and turnips in wet districts. In such circumstances they are slowly rendered more soluble by soil acids, and over a period of years they may prove as effective as any other phosphatic fertilizer. At Cockle Park the effect of neutralizing acidity by first applying lime was to lower the effectiveness of ground mineral phosphate.

It is specially important in the present state of the national economy to obtain the utmost possible recovery of applied phosphate. Complete fixation is least likely to occur when phosphate is concentrated in the vicinity of plant rootlets as by a combined seed and fertilizer drill. Not all of it is then in close contact with the soil. Consequently it is more likely to persist in an available form. And on soils of high fixing power granular forms are more likely to favour recovery than are fine powders.

With broadcasting recovery is likely to be greater when the fertilizer is harrowed into the soil than when left on the surface.

In Swedish and American trials mixing with farmyard manure seemed to increase the recovery of phosphate from superphosphate. Possibly this also has something to do with avoidance of direct contact with the soil. In addition there would be some liberation of carbon dioxide from the decomposition of the organic matter, and this would increase the availability of the phosphate. It is widely recognized as sound practice to apply phosphate over dung for potatoes, and I know of no surer means of improving old pasture over chalk (supposedly very fixative) than a dressing of dung and phosphate, either superphosphate or high grade slag.

J. G. Stewart.

Farming Cameo:
4. Castle Ward and Tynemouth, Northumberland

This district lies on the north bank of the River Tyne and extends westwards from the coast some 25 miles inland in a belt about 10 miles deep. The total area of agricultural land is about 106,000 acres, two-thirds of which is in grass. The district contains much of the Northumberland coalfield and also the industrial area on the north side of the Tyne. Much valuable land has been taken for industrial and housing purposes over the past decade, and the agricultural output has also been reduced by mining subsidence and opencast coal operations.

The soil is derived mainly from glacial drift, giving strong loams with a Boulder clay subsoil, which produce practically drought-proof pastures. Most of the soil in the eastern arable area is strong to medium loam, and the physical condition of the soil has been improved remarkably by the systematic spreading of refuse from the colliery villages over a considerable period. This refuse contains large quantities of ashes and cinders, which have opened up the heavy clay and transformed it into a fruitful arable soil producing good crops.

Large quantities of basic slag and other phosphatic fertilizers have been used, following the practical example of Cockle Park, and some striking improvements have been made. The accumulation of fertility over the years created a problem in the early part of the war, as the excess of nitrogen present in the old sod made corn crops lodge, and several years elapsed before the land would grow crops that would stand. After a time, the strongest soils became wet and difficult to work when the fibre of the old sod had been dissipated, and the only remedy was to sow back to grass.

Practically every type of farming is to be seen : from the dairy arable farms of the industrial areas, producing milk, wheat and potatoes, through the mixed farms growing wheat and other cereals and potatoes, together with grass-fed cattle, to farms farther west where the main product is grass-fed beef, and finally to a semi-marginal area on the carboniferous limestone, where stock are bred and reared. In the east the farm buildings and cottages are usually adequate for the arable system practised, but in the west, a traditional grass district, cottages are few and buildings barely sufficient even for grassland farming.

Many of the cattle fed on the grass are Irish Angus or Hereford crosses, though some of the Hereford cattle are brought from the south. Shorthorns are still the most numerous dairy breed but their numbers are being steadily reduced in favour of Ayrshires, Friesians, and Red Polls. Milk recording and grading up to T.T. standard have made considerable headway during the past few years. The total number of cattle is about 35,000.

Sheep, of which there are about 50,000, are mainly in the western half of the area ; losses caused by dogs have forced many farmers in the industrial areas to give them up. Flocks of half-bred ewes are most common and are mated with Suffolk, Oxford or Hampshire rams to produce fat lambs. Mule ewes (Border Leicester × Blackface) are found on the higher land, and a few Cheviot flocks in the semi-marginal area are used for producing half-bred lambs.

A fair head of poultry is kept and their numbers could be considerably increased. On some of the poorer farms the sale of eggs is one of the main sources of income. A good number of pigs are found on the outskirts of Newcastle, and the food waste collected from the hotels and cafés is made into swill and converted into pork and bacon. A number of flourishing market gardens are also producing fresh vegetables and tomatoes for the town-dwellers.

R. D. Kirton-Darling, *District Advisory Officer.*

Tractor Tyre Pressures The correct pressure of air in tractor tyres has considerable influence on the life of the tyres. It affects also the performance of the rear wheels in transmitting the power of the tractor and the ability of the front tyres to make the tractor answer readily to the steering.

The tread bars of a pneumatic-tyred driving wheel will clean themselves to some extent by the flexing of the tyre. The amount of flexing depends, in part, upon the amount of deflection, or "flatness," of the tyre, but the tyre must not be used too flat, otherwise it will be damaged.

Tyres wear rapidly if the rubber, or the fabric upon which the rubber is built up, is flexed excessively. If a tyre is not kept pumped up hard enough, its walls become unduly bent where the wheel is in contact with the ground, and may crack.

On a tractor that is pulling a heavy load, the deflected part of an excessively soft rear tyre moves in a complex curve, a kind of ripple. This is because the tractive effort is being taken through the deflected part of the tyre. It may be that a pull of as much as 2,000 lb. in each tyre is trying to drag the outer part of the tyre away from the inner part at a tangent. The softer the tyre, the more pronounced is the ripple, and the more liable is the tyre to be damaged. The complex deformation of the tyre takes place once in every revolution of the wheel, and the wheel goes round about a thousand times in an hour's work.

Besides prolonging the life of the cover, the correct inflation protects the tube. If the tyre is not pumped hard enough, the cover may creep on the rim and tend to take the tube with it. As the valve is clamped in the rim, the creeping tube tugs at the valve until, in the end, the tube is pulled away from the valve.

If the tractor were always running free, with no drawbar load and no ballast, and were always on level, hard ground, it would be easy to specify values for pressures in rear and front tyres, and these values would never need to be changed. It would only be necessary for the pressure to be checked from time to time so that any loss could be made up by pumping a little more air into the tubes.

The tractor is, however, never working in these conditions ; indeed, if it were, it would not be doing its job. It is often ballasted to help wheel grip, and it is always pulling a load, either a trailed load or a load attached directly to the tractor. The drawbar pull usually causes a downward force on the back wheels, and this brings additional back axle weight and additional deflection in the rear tyres. Towing a trailed plough, raised out of work, makes very little difference to tyre deflection, but when the plough is in work, the additional tyre deflect is appreciable. In the case of a directly mounted plough, however, the implement will add weight to the back wheels of the tractor, even when it is out of work and being carried. A one-way pick-up plough may weigh as much as one-third of the normal back axle weight of the tractor operating it.

When a tractor is ploughing, one front wheel and one rear wheel are usually run in the furrow. The other wheels are on the land perhaps 8 or 10 inches higher than those in the furrow. This tilt transfers some of the weight of the tractor from the land side to the furrow side. A medium sized tractor may have a load of, say, 14 cwt. on each back wheel when the tractor is on an even keel. If, however, the tractor is tilted so that one side is 8 inches lower than the other, as it is when ploughing, the weights on the two back wheels change to about 11 and 17 cwt. respectively.

This lack of balance can be allowed for by ballasting one side of the tractor more than the other side. If this is done, the air pressures needed

in the land wheels will be the same as those needed in the furrow wheels, and they will be about 4 lb. per square inch higher than the pressures necessary if the tractor were running, unballasted, on level ground. If no compensating ballast is used, then the furrow side rear wheel tyre ought to be inflated to a pressure 4 lb. per square inch higher than the pressure in the land wheel tyre.

These variations in the optimum air pressures are difficult to keep up with when the tractor is being used for several different duties each day, some on the road and some in the fields. Indeed, with one-way plough work, the tyre pressures would need to be adjusted at the end of every bout. The only practicable method is to find a compromise. The important thing is that the compromise should be on the side of too high a pressure rather than on the side of one that is too low. In dry conditions 16 lb. per square inch in both the rear tyres will allow them to grip satisfactorily, and will not make them so hard that they will bounce. Indeed, 16 lb. per square inch is the pressure recommended for road use for speeds up to 20 miles per hour. A good rule is to try to use the tractor with its tyres always at the pressures recommended for road work, that is 16 lb. per square inch in the rear wheels and 28 lb. per square inch in the front ones. If the soil is wet and the rear wheel treads will not keep clean and will not grip, the pressure can be reduced by 5 or 6 lb. per square inch ; and if the front wheels do not steer firmly, their air pressure can be reduced to about 16 lb. per square inch.

H. J. Hine

Henyards Mr. Geoffrey Sykes, speaking at the Poultry Conference organized by the N.A.A.S. at Spalding on November 16, said that in his opinion henyards offer the most economical method of keeping poultry today. Housing costs are low because, generally speaking, existing farm buildings can be adapted cheaply, or failing that, yards can be erected around a group of poultry houses. Alternatively, straw bales can be used to make a suitable house with a yard enclosed with bales topped with wire netting.

The housing portion itself must be well roofed, adequately ventilated and lighted, and dry. The floor space needed per bird is around 2–3 sq. feet. The yard attached to the house can be of any size, but a minimum of 2–3 sq. feet per bird here is desirable. Nest-boxes should be so placed in the house that they are in the darkest corner, and long community nest-boxes are to be preferred to individual boxes, since this minimizes egg breakages. Perches are best placed over dropping pits, and whether the pits are open or enclosed is again a matter for personal preference. Mr. Sykes said that he had seen a number of yards with no enclosed droppings pits where the farmer just raked the droppings about now and again.

Unless farmers aim at winter egg production, said Mr. Sykes, no profit in poultry-keeping can be expected. At the present time 60–70 per cent of the country's eggs are produced in the spring and summer, when prices are at their lowest. If this percentage could be transferred to the autumn and winter months, when prices are at their highest, it would make all the difference between a loss or a profit. The moral has been pointed in winter milk production.

An economy in labour suggested by Mr. Sykes was that wherever possible the egg packing shed should be so arranged in relation to the henyard house that the birds gained access to the nest-boxes through holes in the house wall, the nest-boxes being actually in the egg packing room. Eggs could then be pulled straight from the nest into the egg boxes.

Animal Health, 1948 The report on the work of the Animal Health Division of the Ministry of Agriculture for the year 1948,* continues the story of the fight against animal diseases described in the ten year report 1938–47, issued in November, 1949. The report records another encouraging year so far as foot-and-mouth disease, swine fever, sheep scab, fowl pest and parasitic mange are concerned. Great Britain remained free from foot-and-mouth disease until the autumn, but 15 outbreaks occurred in the last 4 months of the year, while swine fever and sheep scab, with 27 and 69 outbreaks respectively, continued the decline shown in the previous report. The fowl pest epizootic which raged in 1947 was over by March, 1948, and from that time outbreaks of this disease were more sporadic. Parasitic mange was, as in 1947, confined to one outbreak. The number of cases of anthrax confirmed each year has varied little since 1945.

A further satisfactory rise is reported in the number of herds attested under the Tuberculosis (Attested Herds) Scheme, which increased by 6,460 during the year. About 17 per cent of the total cattle population of Great Britain were in attested herds by the end of 1948.

Details are included of the action taken during the year under the Orders relating to importation of animals and their protection in transit. An account is also included of the assistance given to enable exporters to comply with the regulations made by other countries to prevent the introduction of disease.

A large section of the report describes the manifold activities of the Ministry's Veterinary Laboratory at Weybridge in the investigation of disease and allied problems. Statistics in the Appendix show the great value to the field work of the diagnosis of disease and the examination of specimens carried out by the Laboratory. An account of the changes effected by the Veterinary Surgeons Act, 1948, is also included.

Gassing Powders for Rabbit Destruction —New Scheme for 1951 The former arrangement for financial assistance towards the cost of a cyanide gassing powder for rabbit destruction expired on December 31, 1950. A new scheme which aims at increasing the availability of approved cyanide gassing powders, will do away with the "permit" procedure, and will enable farmers to buy direct from their own stockists.

A modified form of financial assistance has been arranged direct with the manufacturers, who have undertaken that the retail prices for a fixed period of three years from January 1, 1951, shall not exceed 15s. per 7-lb. container, or 21s. per 10-lb. container.

So far, approval under this scheme has been given to :

Plant Protection, Ltd.—in respect of the powder under the trade name "Cymag" ;

Metallurgical Chemists, Ltd.—in respect of the powder under the trade name "Cyanolime" ;

Bugge's Insecticides, Ltd.—in respect of the powder under the trade name "Gasit".

*Obtainable from H.M. Stationery Office, or through any bookseller, price 1s. 6d. (1s. 8d. by post).

Suggested Seed Mixtures for Grassland The National Agricultural Advisory Service in consultation with the Seed Production Committee of the National Institute of Agricultural Botany, the Grassland Research Station and the Seed Trade, suggests the following grass seed mixtures for the 1951 season. Some of the strains specified may be scarce, so if the use of alternatives becomes necessary, farmers should seek advice as to modified mixtures.

1. ONE-YEAR HAY LEY
For aftermath grazing

	lb. per acre
Italian ryegrass	6
Perennial ryegrass	6
Broad red clover	4
Late-flowering red clover	2
	18

2. TWO-YEAR HAY LEYS
For aftermath grazing

	lb. per acre
(i) Timothy	8
Late-flowering red clover	5
White clover	1
	14

	lb. per acre
(ii) Timothy	6
Meadow fescue	5
Late-flowering red clover	4
White clover	1
	16

3. SHORT-DURATION GRAZING LEYS
(Two or three years)

	lb. per acre
(i) Italian ryegrass or New Zealand short-rotation ryegrass	4
Perennial ryegrass	10
Late-flowering red clover	2
Broad red clover	4
White clover	1
	21

	lb. per acre
(ii) Italian ryegrass or New Zealand short-rotation ryegrass	4
Cocksfoot	12
Late-flowering red clover	3
White clover	2
	21

	lb. per acre
(iii) Timothy	8
Meadow fescue	8
White clover	2
	18

4. LONG-DURATION GRAZING LEYS, SIMPLE MIXTURES
Using bred strains

	lb. per acre
(i) Perennial ryegrass, certified S.24	6
Perennial ryegrass, certified S.23 or S.101	6
White clover, certified S.100	1½
Wild white clover, certified S.184	½
	14

	lb. per acre
(ii) Timothy, certified S.48	10
White clover, certified S.100	1½
Wild white clover, certified S.184	½
	12

	lb. per acre
(iii) Cocksfoot, certified S.37	6
Cocksfoot, certified S.26 or S.143	6
White clover, certified S.100	1½
Wild white clover, certified S.184	½
	14

5. LONG-DURATION LEYS FOR GENERAL PURPOSES

Three-year ley (Cockle Park type)

	lb. per acre
(i) Perennial ryegrass	14
Timothy	4
Cocksfoot	8
Late-flowering red clover	4
White clover	½
Wild white clover	½
	31

This mixture is designed for undersowing and not for direct seeding

Without ryegrass—using bred strains

	lb. per acre
(ii) Cocksfoot, certified S.37	3
Timothy, certified S.48	6
Meadow fescue, certified S.53	6
Late-flowering red clover, certified S.123	2
White clover, certified S.100	1½
Wild white clover, certified S.184	½
	19

	lb. per acre
(iii) Timothy, certified S.48	6
Meadow fescue, certified S.53	6
White clover, certified S.100	1½
Wild white clover, certified S.184	½
	14

6. LUCERNE MIXTURES

	lb. per acre
(i) Lucerne (inoculated)	14
Cocksfoot	3
	17

	lb. per acre
(ii) Lucerne (inoculated)	14
Timothy	3
	17

	lb. per acre
(iii) Lucerne (inoculated)	14
Meadow fescue	3
	17

BOOK REVIEWS

Dairy Bacteriology (3rd Edition). B. W. Hammer. Chapman and Hall. 36s.

Hammer's *Dairy Bacteriology*, first published in 1928, was originally based on the material used by this author for teaching dairy science to students who, *after* a course in general bacteriology, were having more specialized training in the application of bacteriology to the technology of milk production, handling and manufacture. In the two editions published since 1928, "Hammer" has maintained its place as one of the most solid of dairy bacteriology text-books—comprehensive, factual, objective, and informative.

The present (third) edition is 100 pages longer, and pays rather more attention to liquid milk, pasteurization and milk powder, than the second edition. It gives also a new chapter to the bacteriological quality of water supplies to be used in different types of dairy plant. Otherwise, the field covered is much the same as in earlier editions. Bacteriological quality of raw milk, sources of contamination and their control, bacteriology of filtration, clarification, etc., milk enzymes, diseases that may be conveyed by milk and dairy products, pasteurization, the bacteriology of all the principal dairy products and of water supplies for dairies, are the main subjects dealt with.

The text is well documented, with a list of references at the end of each chapter. It is inevitable that the great majority of papers quoted are in the English language ; in fact, they are mostly American, though references to more of the European continental findings would in places add to the value of the book.

There can be few senior students of dairy bacteriology or dairy technology who do not already know their "Hammer" in the first or second edition. In the present volume the former standards—solid common sense and straightforward style with no frills nor wild statements—are maintained.

The book suffers a little from the defects of these virtues ; I would have liked to have found, here and there, the great experience of the author blossom into a critical assessment of a doubtful or developing situation, and, perhaps, occasionally afford the reader an inspiring insight into an engrossing fundamental problem. Most dairy bacteriology is inherently far from dull, but a little jam, occasionally, does students no harm. Further, some of the biochemical aspects are treated rather scantily ; it is doubtless assumed that these have been dealt with in the general course which students are expected to have taken before reading this text-book.

These are matters of opinion ; there can be no two opinions as to the outstanding value of this treatise to the dairy bacteriologist, whether student or practitioner.

H.D.K.

Pigs. Their Breeding, Feeding and Management (3rd Edition). V. C. Fishwick. Crosby Lockwood. 15s.

Mr. Fishwick's work on pig husbandry at Wye College is well known ; his first book on pigs was published in 1939. The basis of the book was the results obtained in the Wye herd during the previous twenty-three years. The book has run through two editions and several reprints, in itself a recognition of its appeal, and now a third edition has been published. The material has been revised and brought up to date, and new chapters on the selection and rearing of young boars and on current practice on a number of commercial holdings have been added.

The advice on rearing young pigs which covers also the management of sows and boars is detailed and sound, and the author rightly stresses the bad effects of malnutrition in early life. The chapters devoted to the production of bacon and pork pigs set out clearly market requirements and types, but there may be too rigid a distinction made between the feeding and management of the two types, since often in practice a farmer caters for both markets—a fact recognized by the author when later discussing in a very readable manner some matters of policy.

Pigs are housed under widely different conditions and opinions vary on the merits of different types of housing. The author might have dealt more fully with this subject. The drawings and appendix will be helpful in constructing wooden buildings on the farm. Again, although it might be argued that the proper place to deal with disease is in a veterinary book, reference to diseases is rather limited.

A valuable section in the chapter on feeding deals with the use of swill, and the explanation on substituting various foods is clear. Guidance on costs and returns can be followed easily.

The book is well printed and furnished with good illustrations. It should prove very helpful to practical pig-keepers.

J.W.R.

Trees for Town and Country (2nd Edition). BRENDA COLVIN. Lund Humphries. 25s.

Since the first edition of this fine book appeared three years ago, there have been some notable changes in the attitude of the public towards the landscape planting of timber trees. The unique work of our eighteenth and nineteenth century landowners and farmers, in laying out magnificent parks, avenues, and shelter-belts, has at last become generally appreciated. Woodlands are no longer taken for granted as part of a so-called "natural" countryside, and it is realized that changes in their extent and composition are inevitable if we are to make good use of one of our country's valuable resources—its power to grow timber. In 1947 the Ministry of Town and Country Planning was empowered to make Tree Preservation Orders to protect trees and woods of acknowledged amenity value, and such orders commonly provide for a reasonable degree of timber felling and replenishment of the crop. In 1949 local planning authorities were given powers to plant trees "on land in their area for the purpose of preserving or enhancing the natural beauty thereof;" nevertheless the main responsibility of safeguarding and extending the beauties of trees and woodlands remains, as before, with those who draw their living from the land. The Poplar Grant Scheme, announced by the Forestry Commission in June, 1950, will appeal to many farmers who wish to grow a tree that is not only handsome but profitable and quick-growing, and one that will thrive on odd, unutilized corners of farm land; much of its timber, incidentally, is made into the chip baskets that are so essential for the marketing of soft fruit.

The sixty trees described in Miss Colvin's book are all depicted in excellent full-page photographs, as well as in line drawings by S. R. Badmin, and the rich variety of planting material available to the modern landscape architect is well and beautifully displayed.

H.L.E.

Farm Work Simplification. LAWRENCE M. VAUGHAN and LOWELL S. HARDIN. John Wiley (New York). Chapman and Hall. 17s.

This is a comprehensive review of American research work on the science of labour organization. It brings the subjects conveniently together under one cover and is right up to date. It is the first book of its kind and is very well presented, giving a complete basis on which to build future studies. It can be read in approximately four hours, and if read intelligently will enable one to make small changes which could undoubtedly save many hundreds of hours in the course of a year. "Some farmers do a good job with less labour, few farmers do all jobs equally well." This is the basis on which the science of labour studies is built. In America, as in England, every job studied shows very wide variations in efficiency, and often it can be shown that these wide variations are largely due to lack of attention given to important details. Work simplification studies reveal these weaknesses.

The book is divided conveniently into six parts. Part I describes the place of work simplification in farming practice and is written for farmers. Part 2 describes what has actually been done on farms. Part 3 outlines the principles underlying efficient work. Part 4 describes how to use the results obtained to improve traditional methods. Part 5 is a section giving advice to research workers, and Part 6 deals with staff training in work simplification methods.

The writers discuss, too, the human factor, and anyone with experience of labour organization cannot doubt the supreme importance of this, for undoubtedly a worker who knows his methods are of proven value gets considerably more satisfaction and pride from his efforts.

There is a tendency in farming, as indeed in other industries, to become so accustomed by usage to our methods, that we tend to lose our capacity to criticize the very obvious defects. Reading this book, I think, will enable many to remove the blinkers and open their eyes, and minds, to this new approach to economic production. The questions on why, what, where, when, who and how are asked at every stage throughout a process; this in itself is a very good thing, and I feel it would enable a team of, say, agricultural economists, research-minded farmers and District Officers of N.A.A.S. staff to produce results which could be crystallized for consideration of the farming community in general, giving a strong lead to increased food production with less effort. The writers suggest that every problem should be tackled in a scientific manner, the process being first, to observe, secondly, to think, thirdly, to decide on a better way and fourthly, the application of the ideas.

The research chapter gives a suggested procedure which has been worked out to use on any job, and the writers claim that by applying this method results are more valuable and better understood by the farming community.

The writers, I think, have probably over-analysed the subject in the research section and, personally I am very sceptical of the suggestion to standardize the research approach; I feel rather that this should be worked out according to the temperament of the research worker himself.

Farm Work Simplification is a first-class introduction to a most valuable subject.

J.R.S.

BOOK REVIEWS

Dentition as Indicative of the Age of the Animals on the Farm. PROFESSOR SIR GEORGE T. BROWN. 2s. 6d.

The Royal Agricultural Society is to be congratulated on publishing a revised edition of its little book *Dentition as Indicative of the Age of the Animals on the Farm*. The introductory remarks rightly point out that "judging the age by the teeth is an ancient art, the origin of which may perhaps be dated back to the time of the domestication of the horse—an animal which, for commercial and economic reasons must have attracted more attention than those which were used for food". This system of ageing was extended to other domestic animals during the past century following upon detailed observations at the Royal Agricultural College Farm. It was found that a reasonable assessment of age could be made even though animals of the same breed were fed in different ways. Neither the intensive feeding which produced early maturity nor the poor feeding of animals which delayed maturity materially altered the eruption of the teeth at regular ages.

The horse, cow, sheep and pig are dealt with in this book—more than half of which is devoted to the horse. This is understandable as a more detailed study has been made of the ageing of this animal owing to the position it has held through the ages. Valuable information, however, has been gathered on the development of teeth in the other farm animals. The ages of cattle, sheep and pigs can only be judged with any degree of accuracy during the period occupied by the cutting of the temporary teeth and their replacement by permanent ones, but the horse has a peculiar conformation of the teeth which enables the expert to form an opinion of the animal's age long after the appearance of all the permanent teeth. This fact was well known to "dealers" who were very adept in the art of ageing and who were known in the past even to "arrange" the shape of the teeth of an aged animal to make it appear younger. Such men were known as "horse copers", and this practice became so widespread that few people would buy animals until they had been "vetted". (A term which is now universally recognized as implying a most thorough and reliable examination.)

The detailed description given together with fairly clear illustrations make this a useful and necessary book in the farm library. The difficulties which might be encountered by the beginner are well covered. A warning is given against the pitfall of confusing temporary and permanent teeth, e.g. the temporary incisors of a one year old colt and the permanent ones of a five year old horse.

The book concludes with a very useful and concise table which indicates very clearly the state of dentition at different ages in cattle, sheep and pigs.

A.G.B.

Farmer and Stock-Breeder Year Book, 1951. 7s. 6d. (postage 6d.)

We have come to expect a high standard in year books from the Farmer and Stock-Breeder. This year's (the 75th) is as good as ever, both in its presentation and usefulness. There are three main sections: (1) a set of ten articles; (2) a 64-page photogravure record of outstanding pedigree stock of the year; and (3) a 112-page reference section, adequately indexed. New features comprise explanatory notes on national insurance for the self-employed, weather information and income tax. A desk book if ever there was one.

D.H.

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